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CHATTANOOGA WASTE DISCHARGES. PART I.
UPSTREAM FROM THE CITY WATER COMPANY
INTAKES

David W. Hill, et al

Environmental Protection Agency
Athens, Georgia

September 1972

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CHATTANOOGA WASTE DISCHARGES ✓

PART I

UPSTREAM FROM THE CITY WATER COMPANY INTAKES

Technical Study Report TS-04-73-02

Environmental Protection Agency
Region IV
Surveillance and Analysis Division
Athens, Georgia

September 1972

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This report was prepared under the direction and supervision of Dr. David W. Hill, Chief, Industrial and Special Studies Branch. Mr. Charles A. Sweatt served as Project Engineer for the planning and conduct of the field survey. Principal authors are David W. Hill, Charles A. Sweatt, and William R. Davis. All participating EPA personnel are stationed in Athens, Georgia, as part of the Surveillance and Analysis Division under the direction of Mr. John A. Little.

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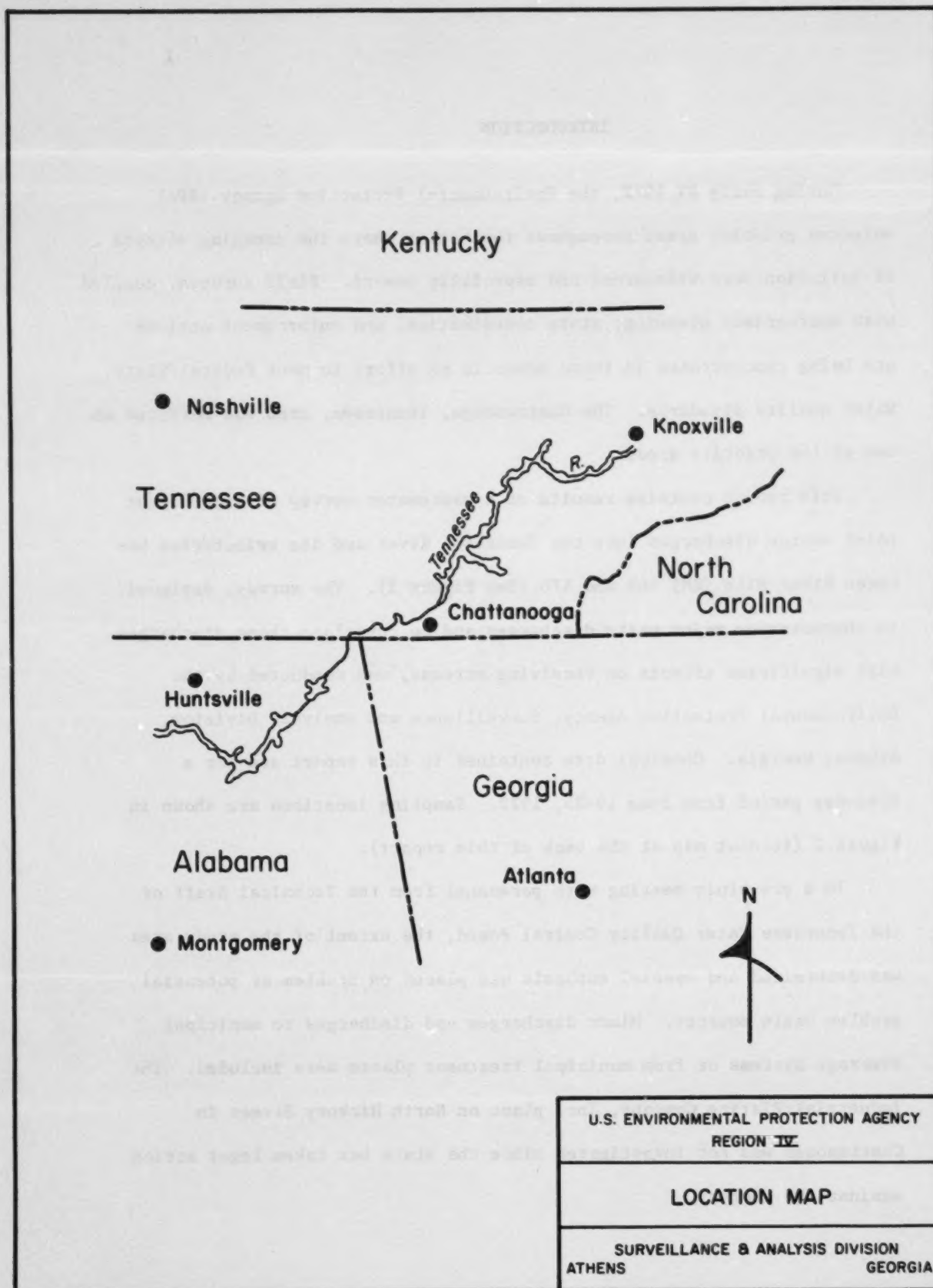
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INTRODUCTION

During early FY 1972, the Environmental Protection Agency (EPA) selected priority areas throughout the nation where the damaging effects of pollution were widespread and especially severe. Field surveys, coupled with appropriate planning, state coordination, and enforcement actions are being concentrated in these areas in an effort to meet Federal/State water quality standards. The Chattanooga, Tennessee, area was selected as one of the priority areas.

→ This report contains results of a wastewater survey of significant point source discharges into the Tennessee River and its tributaries between River Mile (RM) 465 and 476. (See Figure 1). The survey, designed to characterize major waste discharges and to correlate these discharges with significant effects on receiving streams, was conducted by the Environmental Protection Agency, Surveillance and Analysis Division, Athens, Georgia. Chemical data contained in this report are for a five-day period from June 19-25, 1972. Sampling locations are shown in Figure 2 (foldout map at the back of this report).

In a pre-study meeting with personnel from the Technical Staff of the Tennessee Water Quality Control Board, the extent of the study area was determined and special emphasis was placed on problem or potential problem waste sources. Minor discharges and discharges to municipal sewerage systems or from municipal treatment plants were included. The Industrial Plating Company, Inc. plant on North Hickory Street in Chattanooga was not investigated since the state has taken legal action against the company.



The specific objectives of this study were:

- To characterize major waste discharges to the Tennessee River and tributaries between the city water intake and Chickamauga Dam.
- To determine possible violations of intrastate stream standards on Citico Creek and Friar Branch.
- To determine general water quality at the city water intake and possibly identify specific organic compounds discharged from upstream industries.
- To provide information for appropriate abatement actions.

Weather conditions during the study were cool and wet. On Tuesday, June 20, 2.30 inches of rain fell on the area causing excessive runoff from the plant sites and overloading many treatment facilities. Under these conditions, accurate flow discharge measurements were difficult or impossible to obtain. Temperatures averaged 66°F for the six-day period, which was approximately 6°F below normal.

The cooperation and assistance of the Tennessee Water Quality Control Board, the Tennessee Valley Authority, the Chattanooga City Water Company and the various industries investigated are gratefully appreciated.

FINDINGS

1. Grossly-polluted conditions exist on Citico Creek due primarily to excessive oil and grease discharges from the Southern Railway Yards. Oil and grease concentrations as high as 89.0 mg/l were observed in the creek. At least three combined sewers enter the creek untreated from the yards. The oil removal system on the main waste discharge (Station 1) provides reasonably good oil removal except during periods of high surface runoff when the system is flooded and provides essentially no treatment. (Oil and grease in the discharge was 150 mg/l during the heavy rains of Hurricane Agnes.) The excessive BOD₅ loadings discharged at Stations 1 and 2 (means of 53 and 32 mg/l, respectively) exceed the assimilative capacity of Citico Creek. The creek in its present condition is suitable only for waste transport. It is toxic to aquatic life and unsuitable for this and other beneficial uses as included in the proposed state classifications. Seven out of 11 dissolved oxygen (DO) measurements were less than 3 mg/l; the other four measurements were all less than 5 mg/l. Total and fecal coliform geometric mean densities near the mouth of the creek were 110,000 and 18,000/100 ml, respectively. Very heavy chlorine applications effectively disinfect the effluent stream as well as a large portion of Citico Creek below the effluent. Coliform concentrations were less than 20 MPN/100 ml at Station C-1A immediately below the effluent.
2. Tennessee Finishing and Dyeing Company discharges untreated textile dye waste into Poe Branch. The branch is grossly polluted at Station

20A, 0.7 mile below the waste discharge with 0.0 mg/l average DO and 76 mg/l average BOD₅. Even though the stream is not suitable for any beneficial uses, livestock have access to the stream and probably use it for drinking.

3. Amnicola Dump, located on the bank of the Tennessee River, partially below the high water level, is a classic example of where not to locate a dump. The City of Chattanooga operates this facility and permits only demolition materials such as tree limbs, lumber, and building materials to be dumped. These materials decompose and produce a waste very similar to papermill waste. Organic analysis identified and confirmed the presence of fenchone, camphor, alpha terpineol, fenchyl alcohol, and cymene. Total and fecal coliform geometric mean densities were 450,000 and 63,000 per 100 ml, respectively. Salmonella newport was also isolated from the leachate. The city makes no effort to control the foul leachate issuing from the dump.
4. A foul leachate from the abandoned North Hawthorne Street dump flows into South Chickamauga Creek. The poor site selection, the improper manner in which the City of Chattanooga completed the filling operation, and the continued unauthorized use of the dump are the principal reasons for this pollution problem. Solid waste is visibly scattered over the entire irregular, barren surface of the fill. Ammonia in the leachate reached toxic concentrations of 385 mg/l.

5. Alco Chemical Corporation is presently awaiting development, design, and construction of a treatment system. In the meantime, it is retaining all process wastes on site in diked ponds. The level in the pond observed during the study was increasing daily and the dikes appeared to be raised to the maximum safe height. Extreme care should be exercised in raising the dikes since a major spill of this material would have a devastating effect on South Chickamauga Creek and the Chattanooga water supply. Zinc measurements of the impounded wastes averaged 70 mg/l. Dissolved solids averaged 15,500 mg/l and suspended solids averaged 346 mg/l. Total organic carbon (TOC) averaged 527 mg/l. Eight specific organic compounds were identified and the presence of 45 to 55 more noted by gas chromatography-mass spectroscopy.
6. Central Soya provides an excellent level of treatment for its process waste stream; however, a considerable amount of oil and grease (an average of 52.7 mg/l) is discharged through a separate storm water drain. An average BOD₅ load of 142 pounds per day was discharged from the storm drain and 3.7 pounds per day from the process stream. Total phosphorus was high in both the process and storm water discharges, averaging 67.5 and 17.2 mg/l, respectively. Fecal coliform geometric means for both discharges were 170,000 and 180,000 per 100 ml, respectively. Some fecal contamination must originate either from domestic waste or from wildlife in the immediate plant area.

7. DuPont at the present time is a major source of pollution discharging into the Tennessee River. The \$3,000,000 activated sludge system now under construction and scheduled for completion in 1974 should rectify this situation. During the recent study, the company discharged an average of 1,545 pounds per day of BOD₅ and 720 pounds per day of oil and grease.

When DuPont installs air scrubbers, the ammonia content of the raw wastewater will increase significantly. Failure to nitrify these wastes could increase the oxygen demand in the Tennessee River and cause possible locally-toxic conditions for fish life. Ammonia wastes also may cause excess chlorine demand for drinking water supplies.

8. Farmers Chemical Association, Incorporated, is installing a very sophisticated ion exchange process in its waste treatment and recycle system. The wastewater quality has improved considerably since 1968, but not yet to the expected obtainable level of the ion exchange units. Several start-up problems with this first-of-a-kind technology have occurred. During the recent study, an average of approximately 2,000 pounds per day of nitrogen was discharged from this facility to the headwaters of Friar Branch. Of this total load 720 pounds per day was in the form of ammonia. This waste load should be greatly reduced at the date of this writing (September 1972) as a result of the new treatment facility.
9. Imperial Chemical Industries (ICI), American Division, operates the TNT plant at the Volunteer Army Ammunition Plant near Chattanooga.

At the present time, this facility is contributing a heavy pollution load to Waconda Bay in Chickamauga Lake. Modernization of the production facilities are underway and scheduled to continue through 1976. Gradual stepped improvements should appear in the wastewater discharge as each of the new processes come on line. During this study, an average of 2,154 pounds per day of nitrogen, 1,640 pounds per day of BOD₅, and 99,800 pounds per day of total solids were discharged.

10. The visual appearance of the GAF Corporation treated wastes improved markedly after the initial EPA reconnaissance. Loadings during the survey averaged 82.3 pounds per day of BOD₅ and 34.7 pounds per day of ammonia. Dissolved solids averaged 3,628 mg/l, but suspended solids averaged only 34 mg/l.
11. The water quality in Friar Branch in the vicinity of GAF has improved significantly since the State and Federal studies in 1968 (1, 2). The highest ammonia concentration measured during this 1972 study in Friar Branch at the Airport Road bridge (Station F-1) was 20.2 mg/l in contrast to several ammonia measurements in excess of 100 mg/l in 1968. More importantly, no statistically significant fish mortality occurred in the June or August 1972 bioassay tests in Friar Branch in contrast to the acute toxicity within 24 hours measured in 1968. This does not indicate that the stream will allow propagation of fish and aquatic life but points out a significant improvement in water quality over the past four years. Further

evidence of improvement is the result of taste pannel tests of catfish caged for 48 hours in Friar Branch and South Chickamauga Creek. There was no off-flavor or decreased desirability in the edible portions of any of the test fish.

12. During the June EPA study, Hills Hosiery Mill, a small 35-employee operation located in Daisy, Tennessee, completely diverted or shut down the normal small discharge of textile dye waste from its operation. This waste had been discharged to Poe Branch on the earlier reconnaissance trip in May. These wastes may have been discharged out the rear of the building to an open field rather than to the ditch, since the owner was aware of the survey dates.
13. Mueller Company provides very little maintenance and attention to its process waste treatment system. The two concrete settling basins designed to be alternately filled and drained were not being operated properly. The discharge ditch below the basins was overgrown with vegetation, and the discharge weir was rusted out. With proper maintenance and operation of the system, the effluent quality could be improved. Phenol concentrations in the waste ranged from acceptable (0.04 mg/l) to intolerable (8.0 mg/l). The variability of these wastes suggests a controllable in-plant source.
14. The very concentrated small volume of waste (mean BOD₅ of 1,675 mg/l in a mean flow of 10.5 gallons per minute) from Seaboard Allied Milling Corporation is discharged untreated to the Tennessee River. This waste could easily be treated biologically to eliminate this

load from the river. Geometric mean total and fecal coliform densities were 140,000 and 78,000 per 100 ml, respectively.

15. Tech Finishing (owned by Industrial Plating Company), located on a small tributary to Citico Creek, has in the past discharged a considerable amount of chromium to the creek and grounds around the plant. Even though the company is now containing its wastes, spills could easily go undetected, and in-plant spills would be difficult to contain. Chromium concentrations showed a measurable increase from upstream (less than 0.05 mg/l) to downstream (0.35 mg/l) of the plant.
16. Waste from the W. R. Grace Chemical Company is segregated on site and transferred to one of three settling ponds. The concentrated phosphate and thorium wastes are placed in separate ponds which have no surface discharge. Other process wastes are discharged to a large flow-through settling pond, whose discharge had a pH range of 9.6 to 11.8 and an average phosphorus load of 220 pounds per day.

The company also has a small leachate stream flowing from a solid waste disposal area containing some radioactive materials. Radium in the dump leachate is the only component that exceeds drinking water limitations and could be construed as a possible hazard. Hydrofluoric acid is neutralized in a small pond and is discharged to the dump area when the process is in operation. The dump leachate stream was strongly acid with high iron and manganese concentrations.

17. The Chattanooga City Water Company withdraws water from the Tennessee River at mile 465.4. The water intakes are about 135 feet upstream of the confluence of Citico Creek and downstream from all industries

discussed in this report except those discharging to Citico Creek. Average river flow during this study was 36,530 cfs, which is near the mean for the period of record. Measurable phenol concentrations of 8 and 12 $\mu\text{g/l}$ were found on two days of the survey. These levels, along with probable higher levels expected at lower river flows, could cause serious taste problems.

The total coliform densities measured at Station A during the heavy rains of June 20 and 21 indicated technical violations of Tennessee's domestic raw water supply standards based on monthly arithmetic averages of total coliform densities. (Two out of five samples exceeded 10,000 per 100 ml and one out of five exceeded 20,000 per 100 ml.) However, the determined 1,600 per 100 ml geometric mean for fecal coliform did not violate the most recent Federal recommendation of 2,000 per 100 ml as discussed in the EPA Manual for Evaluating Public Drinking Water Supplies. One serotype, Salmonella cubana, was isolated at Station A. Ammonia concentrations averaged 0.20 mg/l.

The water quality of the Tennessee River in the vicinity of the Chattanooga Water Intake, while still acceptable as a water supply source, is nevertheless deteriorated by untreated and poorly treated upstream waste discharges. (During periods of backflow in Nickajack Lake, wastes carried by Citico Creek compound the problem.) All these waste sources should provide the best practical treatment (as now required by law) at the earliest possible time. Even after adequate treatment is installed, however, the possibility of waste spills will require continuous attention.

RECOMMENDATIONS

1. Effluent limits for the industries discussed in this report should be developed by EPA Permit and Surveillance and Analysis personnel in close coordination with the Tennessee Water Quality Control Board. Pretreatment requirements for discharge to municipal sewerage systems should be developed by EPA Construction Grants personnel in conjunction with State and Local officials.
2. In order to eliminate the grossly-polluted conditions in Citico Creek, the Southern Railway System must devote a major effort to pollution control, spill prevention, and control of its contaminated stormwater runoff. Process wastes now being treated in the oil separator system should be separated from contaminated surface runoff. Pipes rather than open ditches should be used to transport the process wastes. Some form of biological treatment should be provided for reduction of the BOD₅ before discharge to Citico Creek. Another possible option would be oil separation and any other required pretreatment followed by discharge to the municipal system. The company should also collect and treat their several other waste streams now flowing untreated to Citico Creek. These waste streams will require oil separation and biological treatment. The following schedule established by the Tennessee Water Quality Control Division on April 26, 1972, should be enforced:
 - A. Submission of engineering report 8/72
 - B. Submission of final plans and specifications 1/73
 - C. Begin construction 6/73
 - D. End construction and start operation 6/74

3. The Tennessee Finishing and Dyeing Company should be required to provide the best practicable treatment for its wastes. A small aerated pond or a packaged extended aeration plant may be applicable. Initial plans for waste treatment should be presented to the State by March 31, 1973; final plans should be submitted by May 31, 1973; and construction should begin by July 31, 1973. The treatment system should be in operation by July 31, 1974.
4. The Amnicola dump should be closed by February 1, 1973. It cannot be continued for "demolition materials" disposal, because these materials themselves are the source of putrefaction within the dump.
5. The North Hawthorne Street Dump should be closed by March 1, 1973.
6. Measures must be taken at the Amnicola dump (even after it is closed) and at the North Hawthorne Street dump to minimize the amount of leachate produced and its travel from the area. This can be done by reducing the hydraulic gradients that cause water to move through the fill and by eliminating the source of the water. This may be done by several methods such as:
 - Tight earth dam between refuse and approaching groundwater.
 - Collection and diversion of all surface and groundwater before it reaches the fill area.
 - Equalization and maintenance of water level on all sides of the fill.
 - Compaction of refuse and covering the top and faces with an impermeable cover material properly graded for runoff.

Gas vents must be installed when the surface is sealed.

- Seeding the closed area with a high transpiration cover crop (3).

In order to stop the flow of leachate from the two problem areas, all or a combination of the above methods may have to be used.

If the leachate cannot be economically stopped, then it will need to be collected and treated.

7. The Alco Chemical Corporation's elevated waste storage pond used during the EPA study for process waste storage is potentially dangerous. A limit should be placed on the height that the dikes can be raised on the waste storage pond and also on the liquid level in the pond. If there is a possibility that the dikes might fail, producing a major waste spill, the company should be prevented from pumping additional waste into the pond. The company may need to provide additional ponds or cease operating until adequate waste treatment is provided.

The following schedule established by the Tennessee Water Quality Control Division on April 26, 1972, should be enforced.

- | | |
|---|----------------|
| A. Submission of engineering report | <u>7/24/72</u> |
| B. Submission of final plans and specifications | <u>1/1/73</u> |
| C. Begin construction | <u>5/1/73</u> |
| D. End construction and start operation | <u>1/1/74</u> |

Pentachlorophenol is the only compound identified for which adequate toxicity data are known; the treated effluent should contain no more than 0.02 mg/l of pentachlorophenyl as a maximum (the average

should be less). Dibutyl amine and n-butyliothiocyanate should be limited to about the same range because of bad taste and odor observed during laboratory isolation procedures. Toxicity data for the remaining identified compounds will be developed by EPA and forwarded to effluent permitting agencies as the data becomes available.

Because of the large number of potentially toxic compounds present in the waste, Alco should be responsible for determining the toxicity or safety of its waste discharge on a continuous basis. Alco should design a waste treatment plant that will provide an effluent of sufficient quality to support sport fish indigenous to the South Chickamauga Creek-Nickajack waters. New treatment facilities should be designed to circulate a portion of the effluent through a fish tank in which live fish will be maintained. If the fish cannot survive, Alco must provide facilities to hold its waste until sufficient treatment is provided such that they will survive.

8. The Central Soya Company should immediately eliminate all oil discharges to the stormwater system or collect this flow and treat it. Initial plans to chlorinate plant effluent to eliminate the bacterial contamination problem should be presented to the state by March 31, 1973. Final plans should be submitted by May 31, 1973; and construction should begin by July 31, 1973.
9. Periodic visits should be made between State officials and DuPont personnel to encourage the company to proceed at a full pace in

development of its planned treatment facilities and to ensure that no interim or final deadlines are missed.

DuPont's schedule, established by the Tennessee Water Quality Control Division on April 26, 1972, should be enforced according to the following dates:

- | | |
|---|----------------|
| A. Submission of engineering report | <u>4/25/72</u> |
| B. Submission of final plans and specifications | <u>3/73</u> |
| C. Begin construction | <u>6/73</u> |
| D. End construction and start operation | <u>6/30/74</u> |

10. Performance of GAF's existing facilities should be checked regularly by State personnel. GAF should either install treatment to further remove the ammonia and suspended solids from their wastes or pretreat and discharge to the municipal waste treatment facility.

The following schedule established October 3, 1972, Amendment of the Tennessee Department of Public Health Commissioner's Order of August 14, 1972, should be enforced:

- | | |
|---|-----------------|
| A. Submission of engineering report | <u>7/1/73</u> |
| B. Submission of final plans and specifications | <u>10/31/73</u> |
| C. Begin construction | <u>12/31/73</u> |
| D. End construction and start operation | <u>7/31/74</u> |

11. Hill's Hosiery Mill should be revisited periodically and if a discharge exists to Poe Branch, the company should be directed to install treatment.

12. The Mueller Company should operate and maintain its waste treatment facilities properly. The company should take appropriate steps to prevent effluent phenol concentrations from exceeding 0.1 mg/l.

The following schedule established by the Tennessee Water Quality Control Division on April 26, 1972, should be enforced:

- | | |
|---|-------------|
| A. Submission of engineering report | <u>1/73</u> |
| B. Submission of final plans and specifications | <u>3/73</u> |
| C. Begin construction | <u>8/73</u> |
| D. End construction and start operation | <u>1/74</u> |

13. Seaboard Allied Mining Corporation should provide treatment for its waste before discharge to the Tennessee River. Preliminary plans to provide waste treatment should be developed by the company and submitted to the State by March 31, 1973. Final plans should be submitted by May 31, 1973; and construction should begin by July 31, 1973. The waste treatment facility should be in operation by January 31, 1974.
14. As a minimum, a Letter of Commitment agreeing to contain spills and not to allow any discharge should be sought from Tech Finishing, a small plating plant owned by Industrial Plating Company, Inc.
15. W. R. Grace should commit to either permanently prevent its fluoride neutralization and holding pond from discharging or to provide a closed conduit to take the wastewater to additional treatment by March 31, 1973. Complete neutralization of hydrofluoric acid is required.

To prevent a possibly unsafe radium discharge in its dump leachate, W. R. Grace should use proper sanitary landfill practices. All surface runoff should be diverted around the landfill and the surface should be properly covered and graded to minimize the amount of surface water entering the landfill.

Although radioactivity measured in the wastewater effluent probably presents no hazard, the mere fact that some radioactivity is discharged is significant. W. R. Grace should be required to take all practicable steps to minimize radioactivity in its discharge. The company should also notify the permit-issuing regulatory agency if there is reason to believe the levels reported herein are being consistently exceeded.

Rare earths are toxic to some aquatic food chain organisms and subject to being concentrated in others (a phenomenon called "biological magnification"). The high pH (9.6 to 11.8) in the final lagoon is very desirable in helping to oxidize and precipitate the rare earths. Therefore, the company should be required to maintain the high pH and allowed to add acid only at or past the discharge weir.

16. The extremely complex process system — waste treatment facility construction schedule of Imperial Chemical Industries for the Volunteer Army Ammunition Plant must be monitored closely to ensure that no interim or final deadlines are missed and that commitments are secured to meet undated pollution control projects. (A detailed facilities schedule is included in the discussion of Volunteer.)

17. Requirements (possibly a state law) are needed for mandatory reporting of all "spills" to both state officials and managers of downstream municipal waterworks. Severe penalties for failure to report spills must be distinct and entirely separate from penalties for causing or having a spill. A complete distinction must be made between the offense of "not reporting" and the offense of "spilling." (The Federal Water Pollution Control Act Amendments of 1972, Section 311(6)(5), provides for a \$10,000 fine for failure to report an oil or a hazardous substance spill.)

18. The interagency Task Force studying the Chattanooga water supply should consider several alternatives (not mutually exclusive):
- o Moving the water intake to a site less threatened by continuous pollution and potential spills.
 - o An alert system to give the City Water Company the earliest possible advance notice of all unusual polluting discharges.
 - o Sufficient off-stream storage of raw water to allow the intakes to be closed during the passage of a pollution spill.

If significant expense must be incurred to protect the water supply from pollution begun after the installation of the existing intake structures, the cost should be borne by upstream polluters. Some equitable assessment might be made such as a share proportional to the total pounds of all pollutants discharged.

STUDY AREA

This survey was limited to discharges to the Tennessee River and its tributaries between river mile (RM) 465.3 (the confluence with Citico Creek) upstream to Harrison Bay in Chickamauga Lake (RM 476). Waste discharges to this reach of the Tennessee River are particularly critical since they are immediately upstream from the Chattanooga water supply (RM 465.4). (See Location Map, Figure 1.)

The study area (Figure 2) includes five miles of Chickamauga Lake and six miles of Nickajack Lake, extending upstream and downstream -- respectively -- along the Tennessee River from Chickamauga Dam. The principal tributaries in this reach are North Chickamauga, South Chickamauga, and Citico Creeks.

North Chickamauga Creek rises near Daisy, Tennessee, approximately 20 miles northeast of Chattanooga. Its upstream drainage area is primarily forest and agricultural land, and the downstream portion is becoming light residential. North Chickamauga Creek flows into the Tennessee River immediately below the lock at Chickamauga Dam. Flow in the downstream portion of the creek is heavily influenced by lock and dam and power releases, creating frequent flow reversals.

South Chickamauga Creek rises in northern Georgia, flows north into Tennessee, and joins the Tennessee River at RM 468.2. The area near its mouth is subject to flow reversals and stagnation depending upon water releases from Chickamauga Dam and the relative flow in the creek. Friar Branch receives wastes from Farmers Chemical Association, GAF, and other

smaller commercial and domestic sources before entering South Chickamauga Creek at RM 8.7.

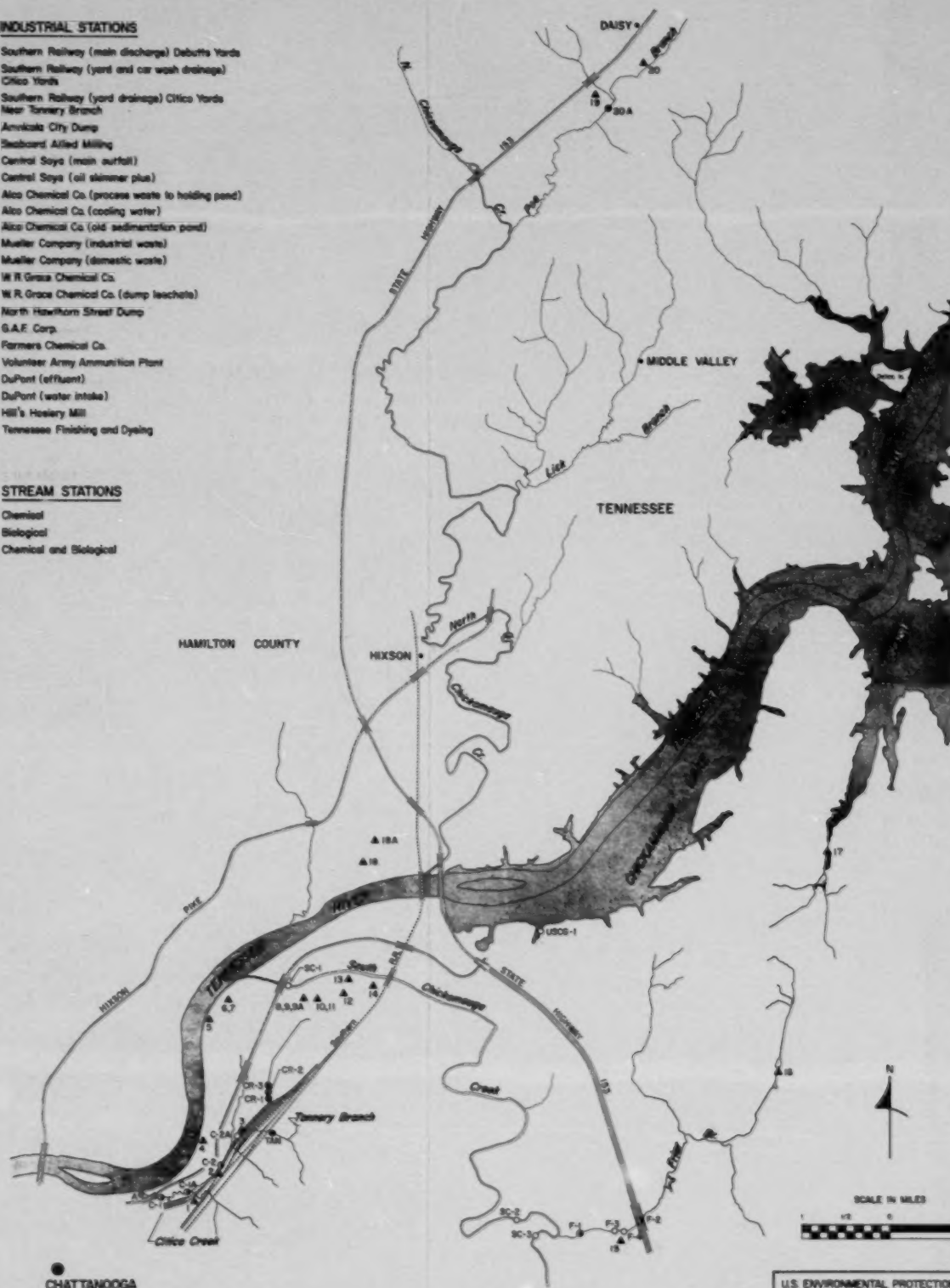
Citico Creek, an intrastate stream, drains the industrial and residential area in the vicinity of the Southern Railway System yards and enters the Tennessee River at RM 465.3, immediately downstream from the Chattanooga water supply intake.

▲ INDUSTRIAL STATIONS

1. Southern Railway (main discharge) Debutts Yards
2. Southern Railway (yard and car wash drainage) Citico Yards
3. Southern Railway (yard drainage) Citico Yards Near Tannery Branch
4. Amvika City Dump
5. Seaboard Allied Milling
6. Central Soys (main outfall)
7. Central Soys (oil slimmer plus)
8. Alco Chemical Co. (process waste to holding pond)
9. Alco Chemical Co. (cooling water)
- 9A. Alco Chemical Co. (old sedimentation pond)
10. Mueller Company (industrial waste)
11. Mueller Company (domestic waste)
12. W R Grace Chemical Co.
13. W R Grace Chemical Co. (dump leachate)
14. North Hawthorn Street Dump
15. G.A.F. Corp.
16. Farmers Chemical Co.
17. Volunteer Army Ammunition Plant
18. DuPont (effluent)
- 18A. DuPont (water intake)
19. Hill's Hosiery Mill
20. Tennessee Finishing and Dyeing

● STREAM STATIONS

- Chemical
- Biological
- Chemical and Biological



SCALE IN MILES



U.S. ENVIRONMENTAL PROTECTION AGENCY
REGION III

SAMPLING LOCATIONS

SURVEILLANCE AND ANALYSIS DIVISION
ATHENS GEORGIA

PRESENT WATER USES

DOMESTIC RAW WATER SUPPLY

The City Water Company of Chattanooga obtains its raw water supply from the Tennessee River at RM 465.4. The submerged water intakes are approximately 135 feet upstream from the confluence with Citico Creek (Figure 3). The company has a capacity of over 36,000 gallons per minute and serves approximately 54,000 user connections in the Chattanooga area.

INDUSTRIAL WATER SUPPLIES

Farmers Chemical Association, Incorporated, pumps more than 40 mgd from Chickamauga Lake. The water is used to supply Farmer's fertilizer operations as well as Imperial Chemical Industries, American Division's TNT operations at Volunteer Army Ammunition Plant. Two pumping stations are located at Tennessee RM 472.4 and 473.0.

E. I. DuPont deNemours & Company obtains approximately 21.6 mgd of water from Nickajack Reservoir at Tennessee RM 470.0. The water is used for cooling and process purposes in production of nylon fibers.

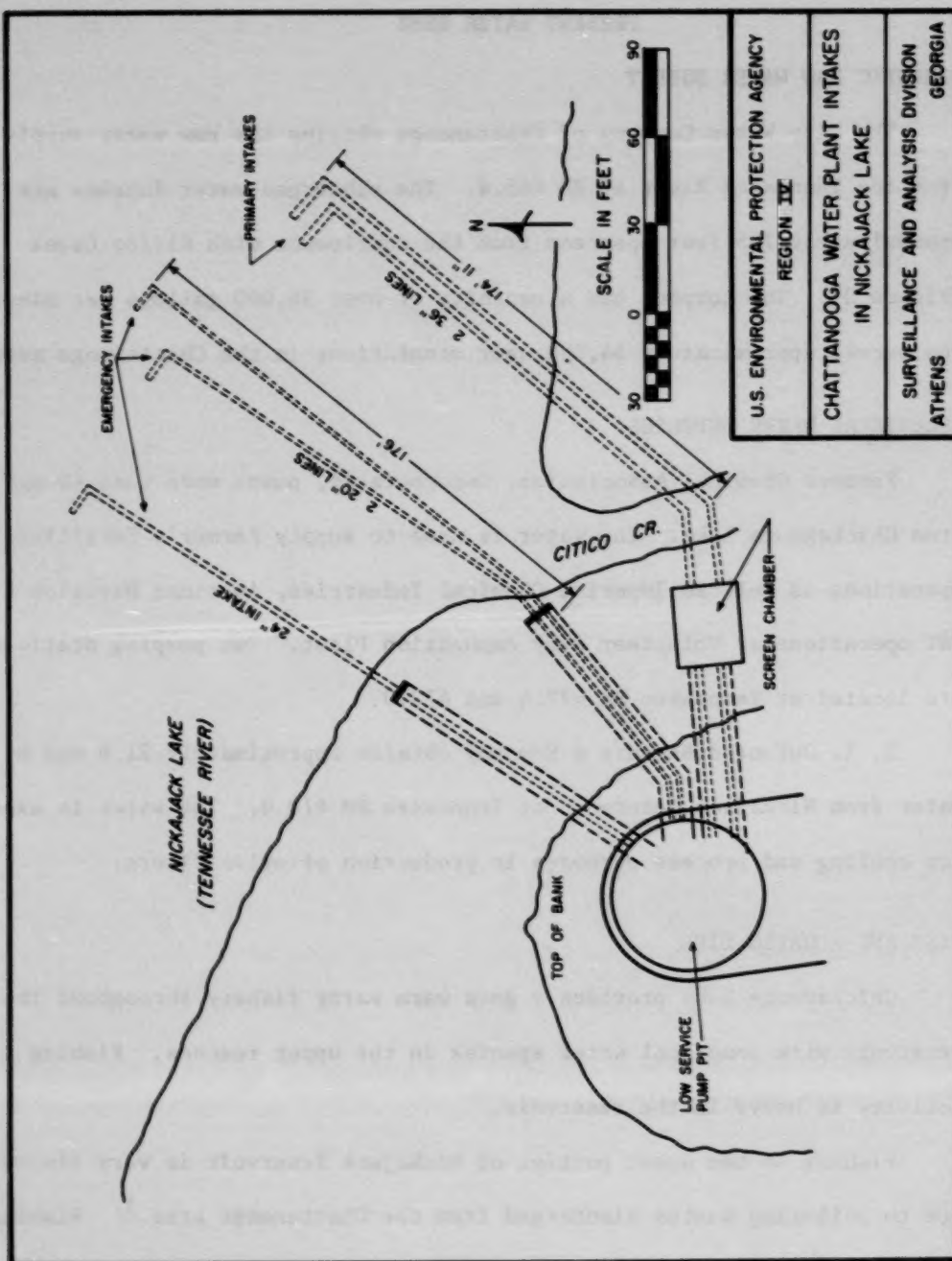
FISH AND AQUATIC LIFE

Chickamauga Lake provides a good warm water fishery throughout the reservoir with some cool water species in the upper reaches. Fishing activity is heavy in the reservoir.

Fishing in the upper portion of Nickajack Reservoir is very limited due to polluting wastes discharged from the Chattanooga area.^{1/} Fishing

^{1/} Testimony by Mr. Dan Sherry, Biologist with the Tennessee Game and Fish Commission at the Tennessee Stream Standards meeting in Chattanooga on December 2, 1971.

FIGURE 3



in the downstream portions of the reservoir is good despite the deteriorated water quality conditions in the upper portion.

Citico Creek and Friar Branch are not suitable for propagation of a diverse aquatic life due to heavy industrial waste discharges. Citico Creek is not even suitable for survival of most aquatic life.

South Chickamauga Creek provides reasonably good fishing for warm water species despite the large volumes of domestic and industrial waste discharged to the stream.

North Chickamauga Creek is a scenic mountain stream supporting trout in the upper reach. The State has classified it for trout from RM 13.2 to the origin. The lower portion of the stream supports a mixture of warm and cool water species.

RECREATION

Chickamauga and Nickajack Lakes are extensively used for pleasure boating activities and swimming. North Chickamauga Creek is an ideal canoeing stream.

IRRIGATION

Irrigation is not widely practiced in the immediate study area.

LIVESTOCK WATERING AND WILDLIFE

This use in the immediate study area is low; however, upper reaches of the tributary streams are extensively used. There are several wildlife and bird sanctuaries in the area.

NAVIGATION

The Tennessee River supports barge traffic through Chickamauga and Nickajack Reservoirs.

PREVIOUS STUDIES

In October 1968, the Federal Water Pollution Control Administration, Southeast Region, Technical Programs (now EPA, Region IV, S&A Division) conducted an intensive 8-day waste quality survey of the same area for ammonia and nitrogen sources (2). Pollution control measures were recommended to protect both fish and aquatic life and water supply uses.

A previous survey in May 1968 by the Tennessee Division of Stream Pollution Control (now Tennessee Water Quality Control Board) indicated that excessive chlorine demand at the City Water Company of Chattanooga was related to ammonia discharge by the Farmers Chemical Association and the flow regime in the reservoir (1).

A comprehensive listing of pollution sources in the Chattanooga area is included in the transcript of a public hearing held on December 2, 1971 (4). This hearing was conducted, transcribed, and published by the Tennessee Water Quality Control Board and includes a discussion of each pollution source.

Several small reports (5, 6, 7) have been issued, though not published, in connection with a Task Force study of pollution and water supply problems affecting Chattanooga's water system. This Task Force, appointed on December 15, 1971, by Dr. Eugene W. Fowhinkle, Tennessee Department of Public Health, is composed of city, county, state, and federal officials who have been meeting periodically since February 28, 1972. This report is designed, in part, to supplement other information furnished to the Task Force.

Both the City Water Company of Chattanooga and the Tennessee Division of Water Quality Control continue to collect periodic water quality samples upstream from the water intake.

STUDY METHODS

GENERAL

This survey was conducted by Surveillance and Analysis Division personnel, EPA, Athens, Georgia, with the assistance and cooperation of personnel from the Chattanooga Field Office of the Tennessee Water Quality Control Board. A mobile, EPA field laboratory was located at the Chickamauga Dam powerhouse. Field crews collected the samples and determined flow and temperature. Bacteriological, BOD₅, acidity, alkalinity, and pH determinations were made in the field laboratory, while additional analyses were performed on samples airshipped to the EPA, Region IV laboratory in Athens, Georgia.

DUMP LEACHATE

Leachate stream from two solids waste dumps were collected as one grab sample per day from each site for five consecutive days. Temporary weirs were installed in each stream for flow determinations. Appendix B lists the samples collected and the analyses performed.

INDUSTRIAL WASTES

Most of the industrial waste discharges in the study area were sampled on a 24-hour composite basis with either EPA or company supplied sampling equipment. Some of the industries had intermittent discharges or operated on less than a 24-hour basis and were sampled by either grab samples or manually-composited samples. Four composite samples were collected at some industries and five at others. Grab samples were taken for analyses of those parameters which required special preservation techniques.

Appendix B contains a listing of waste dischargers, the samples collected, and the analyses performed on each sample. Flows were determined from in-plant flow measuring devices or from temporary weirs installed for the study.

STREAM QUALITY

Stream samples were collected from Citico Creek, Friar Branch, and South Chickamauga Creek. The sampling stations are shown and listed in Figure 2. Samples for chemical analyses and dissolved oxygen were taken at the one-foot depth. Bacteriological samples for coliform were collected near the surface using a grab sampling technique.

BIOLOGICAL

Biological studies were performed concurrently with other activities in June and again during the week of August 7, 1972. These studies concentrated primarily on Citico Creek, Friar Branch, and South Chickamauga Creek. Fish baskets containing bluegill sunfish were set out at six locations in June to determine fish mortality. However, the June results were considered to be significantly affected by the increased stream flow generated by the extremely heavy rainfall on June 20. Studies of more normal conditions improved on the June survey results; the August survey was expanded to include seven locations and catfish were set out for taste analyses. Temperature, dissolved oxygen, pH, acidity and alkalinity were determined when the fish were initially put into the water and visits were made at approximately 12-hour intervals to determine mortality. The surviving catfish, being in the baskets for 60 hours, were frozen and sent to Corvallis, Oregon, for a taste panel evaluation.

WASTE SOURCE RESULTS

GENERAL

The data on which much of the following discussion is based are included in Appendix E. Chemical data are discussed in terms of arithmetic means, while all bacterial data are discussed as geometric means (the anti-log of the logarithmic average) in order to place less importance on extreme values. Table 1 summarizes both total and fecal coliform bacteriological data and shows large differences that frequently arise between average and geometric mean values.

DUMP LEACHATE

Chattanooga has three dumps located on stream banks. Two of these discharge a contaminated leachate to receiving streams upstream from the municipal water supply intakes. Two dumps discharging leachate, the Amnicola Dump and the North Hawthorne Street Dump, are discussed here. The third offending dump is the 38th Street Dump located on the banks of, and partially in, Chattanooga Creek near downtown Chattanooga. Unless adequate corrective measures are taken first, this dump will, in part, be the subject of an EPA study to be conducted in February 1973.

TABLE 1
SUMMARY OF COLIFORM DATA

Station	Total Coliform/100 ml			Fecal Coliform/100 ml				
	Maximum	Minimum	Average	G. Mean	Maximum	Minimum	Average	G. Mean
1	20	20	20	20	20	20	20	20
2	24,000,000	490,000	7,200,000	2,600,000	490,000	49,000	220,000	150,000
3	130,000	14,000	54,000	31,000	79,000	4,000	29,000	11,000
4	1,100,000	170,000	560,000	450,000	490,000	5,000	170,000	63,000
5	2,400,000	11,000	660,000	140,000	2,400,000	2,000	650,000	78,000
6	9,200,000	1,300,000	3,400,000	2,500,000	2,400,000	22,000	780,000	170,000
7	13,000,000	490,000	3,600,000	1,900,000	700,000	70,000	260,000	180,000
14	240,000	2,200	110,000	50,000	17,000	200	4,700	1,300
16	140,000	20	36,000	1,800	4,900	20	2,200	790
17	1,100	20	600	270	790	20	210	50
18	7,900	70	2,400	630	170	20	80	60
18A	1,300	220	820	640	40	20	25	24
19	24,000	1,700	10,000	7,100	7,900	170	3,100	1,600
C-1	1,700,000	2,000	580,000	110,000	220,000	2,000	89,000	18,000
C-1A	2,000	20	1,000	200	2,000	20	1,000	200
C-2	540,000	11,000	150,000	55,000	240,000	2,000	51,000	7,300
CR-1	22,000	22,000	22,000	22,000	2,700	2,700	2,700	2,700
CR-2	17,000	17,000	17,000	17,000	2,400	2,400	2,400	2,400
SC-1	11,000	7,000	9,000	8,800	940	490	720	680
TAN	13,000	11,000	12,000	12,000	3,300	800	2,100	1,600

Amnicola Dump

This "demolition material" dump, leased and operated by the City of Chattanooga, is located on the east bank of the Tennessee River approximately 0.5 miles upstream from the city water intake. Only scrap building materials, tree limbs and stumps, and similar materials are allowed by the City of Chattanooga into the dump. The City is not aware of household garbage or food stuffs being dumped at the site; but industrial wastes, including large quantities of waste latex material, have been dumped as recently as this past year. An attendant is on duty during normal working hours to enforce dumping restrictions, and the site is cabled-off the rest of the time. The foul leachate (Figure 4) was originally thought to be generated from materials illegally dumped in the past. However, the conclusion reached from a characterization of the organic material in the leachate is that "the dump looks like a papermill". (For a listing of the specific compounds found, see Appendix F.) Apparently, the lumber and tree limbs themselves are decomposing and creating the foul leachate. A continuation of present practices will only make conditions worse.

The location of this dump defies all principles of sound engineering judgment. It is located in the flood plain of the Tennessee River and in the natural drainage of a small stream which flows continuously with gray-black, septic leachate. The toe of the slope on the dump is roughly 100 feet from the river's edge, hardly above the high water level of Nickajack Lake (this impounded reach of the Tennessee River). High water may inundate part of the dump area.



Figure 4
Leachate From Amnicola Dump -
Sampling Point 4

Discussion of Analytical Data

Flow from the Amnicola dump was much more influenced by runoff than was runoff from the North Hawthorne Street dump. This was evidenced by the observed high flow of 263 gpm on June 20 and the rapid decrease in flow thereafter to 32 gpm on June 24, giving a mean flow of 100.6 gpm.

BOD₅ concentrations ranged from 20 to 110 mg/l, with a mean of 57.5 mg/l. Based on an average instantaneous flow, the BOD₅ loading was 69.5 pounds per day, nearly 6 times as great as from the North Hawthorne Street dump. Values for pH ranged from 4.6 to 7.0 with most observations being around 6.0. Values are lower by about one pH unit than observed at the North Hawthorne dump. Dissolved solids concentrations ranged from 1307 to 1409 mg/l. These lower residue values may be due to dump content and to faster travel time of the water entering the dump.

Nitrogen concentrations were much lower than those found in the North Hawthorne site, but they were still high values (mean total nitrogen concentration was 22.3 mg/l at the Amnicola dump and 157.18 mg/l at the North Hawthorne Street dump):

	<u>Concentrations in mg/l as Nitrogen</u>			<u>Total Phosphate mg/l as P</u>
	<u>NH₃</u>	<u>TKN</u>	<u>NO₂-NO₃</u>	
Maximum	19.0	36.0	0.50	1.7
Minimum	12.0	17.0	<0.01	1.2
Mean	16.1	22.2	>0.10	1.4

Total Organic Carbon concentrations were much lower than those found in the North Hawthorne Street site, but still represent high carbon content. As time progresses and decomposition accelerates -- especially if the dump is not closed -- TOC concentrations will increase. TOC values ranged from

75 to 93 mg/l, with a mean of 82.2 mg/l.

The only metals found with higher than normal concentrations were iron and manganese. Iron concentrations ranged from 1.95 to 6.25 mg/l with a mean of 3.24 mg/l. Although these concentrations are elevated, they are approximately four times lower than the levels found at North Hawthorne. Manganese concentrations at the Amnicola site were high, ranging from 6.0 to 23.0 mg/l, with a mean of 9.7 mg/l. Based on a mean instantaneous flow, the loading was 11.7 pounds per day.

Alkalinities were approximately three times lower than those found in the North Hawthorne site. Alkalinity concentrations ranged from 477 to 960 mg/l, with a mean of 803 mg/l.

Leachate from the Amnicola dump had a mean total and fecal coliform density of 450,000 and 63,000/100 ml, respectively.

Concentration in mg/l as reported	Concentration in mg/l as reported		Total hardness
	mg/l	mg/l	
Iron	1.95	6.25	7.1
Manganese	6.0	23.0	1.3
Alkalinity	477	960	1.4

North Hawthorne Street Dump

The City of Chattanooga has abandoned this large, improperly-maintained, general use landfill-dump (Figure 5), located along the south bank of South Chickamauga Creek. The main leachate stream (Figure 6) enters the creek at RM 1.4.

Although the dump has been officially closed since the City's lease expired a couple of years ago, unauthorized dumping has continued. The City has repeatedly sent equipment to clear roads in the area by pushing accumulated waste into the dump site. A legal problem now exists as to who is responsible for the area. City officials claim that they have fulfilled all lease requirements and the legal responsibility rests with the owner. Moreover, the City is not sure it has the legal right to move equipment into the area if it chose to take corrective measures.

At present, refuse of all types lies partially exposed throughout the area. This problem is particularly bad around the edges of the dump overlooking the creek. There were several low spots where water is ponding.

Many materials placed in municipal landfills are subject to leaching and water-soluble materials will ultimately contaminate nearby springs and streams. If toxic materials are present, this problem is compounded. Among the major products of anaerobic breakdown of refuse are methane, carbon dioxide, and organic chemicals that have a putrid odor and are high in BOD, chemical oxygen demand (COD), nitrates, and coliform bacteria.

Discussion of Analytical Data

Flow from the North Hawthorne Street dump responded predictably to heavy rainfall on June 20. Flow of 27 gpm on the 20th decreased steadily



Figure 5
North Hawthorne Street Dump



Figure 6
Leachate From North Hawthorne Street Dump -
Sampling Point 14

to 10 gpm on the 24th, with a mean flow of 16 gpm. BOD₅ concentrations ranged from 110 to 10 mg/l, with a mean of 60 mg/l; and dissolved solids concentrations ranged from 4,670 to 2,630 mg/l, with a mean of 3,760 mg/l.

Nitrogen levels were higher than expected when compared to measurements of other sanitary landfill leachate streams. Values determined here were:

	Concentrations as N in mg/l		
	<u>NH₃</u>	<u>TKN</u>	<u>NO₂-NO₃</u>
Maximum	385	385	35.5
Mean	280	305	11.9
Minimum	114	157	0.18

Calculated on an average daily instantaneous flow, the total nitrogen loading was 60.8 pounds per day.

Phosphorus concentrations ranged from 0.53 to 1.0 mg/l, with a mean of 0.86 mg/l.

TOC concentrations reflected the high dissolved organic content of the leachate. The concentrations ranged from 180 to 410 mg/l, with a mean of 316 mg/l.

Total iron concentrations were high, ranging from 4.5 to 15.2 mg/l, with a mean of 12.0 mg/l.

Alkalinities ranged from 1,580 to 4,100 mg/l, with a mean of 2400 mg/l. Alkalinities were close to values found in similar landfills.

Mean total and fecal coliform bacteria densities of 50,000 and 1300/100 ml, respectively, were measured in the leachate stream.

INDUSTRIAL WASTES

The industries discussed here are sources of significant pollution that pose immediate or potential threats to the Chattanooga water supply system and to other downstream water users. The listing is not all-inclusive but is developed as the basis of an action program -- state and/or federal enforcement, if necessary -- to reduce pollution and spill potential in the area.

Alco Chemical Company

This plant, located on the south bank of South Chickamauga Creek, manufactures latex accelerators and thickeners. The plant discharged process wastewater to South Chickamauga Creek until Spring 1972, but now discharges only cooling water. Process wastes are being contained in recently-constructed holding ponds until development and construction of suitable treatment facilities are completed. In an effort to increase the evaporation rate of the pond existing at the time of the study, a spray system was installed around the periphery. The height of the levy has been increased as high as safety will allow. The wastewater in the pond was white and milky in color; had a unique, mild odor; and was high in dissolved solids.

The manufacturing processes involve batch mixing of chemicals such as amines, carbon disulfide, various surfactants, and other organic chemicals which are rich in carbon. High total organic carbon (TOC) waste water concentrations coupled with settleable solids that are high in carbon could lead to severe dissolved oxygen depletion if released to South Chickamauga Creek.

Zinc concentrations were extremely high in the pond and would present a definite hazard to fish and other aquatic wildlife if released. Zinc in high concentrations (30 mg/l and above) gives water a milky appearance (ref. 8, p. 294). It also imparts an unpleasant, astringent taste and can be detected in less than dangerous concentrations in water. Taste thresholds have been reported at 40 mg/l, 25 mg/l, and as low as 2 mg/l (ref. 8, p. 294). The presence of copper, which is likely to occur in South Chickamauga Creek, would have a synergistic effect on the toxicity

of zinc if it were released to the stream (ref. 8, p. 295).

Total organic carbon (TOC) concentrations in the cooling water discharged to South Chickamauga Creek (Sample Point 9) signify that some contaminants are entering the cooling water system. Some of the TOC could originate as carbon disulfide which is stored in a submerged tank constantly flooded with cooling water. However, measurable zinc concentrations in the cooling water indicate another source of contamination as well.

Discussion of Analytical Data

Because the company was not discharging process wastes, samples were collected from a recirculation pump, which was supplying water for the spray system. Since the pond had no discharge, only concentrations are reported. Process water usage was reported to be approximately 12,000 gallons per day.

The BOD₅ values for the impounded process wastes of 280, <1600, and <9000 mg/l resulted from a high initial oxygen demand that appeared to require high dilutions, but did not continue throughout the five days of the test. Zinc toxicity to the test bacteria is a probable explanation. Zinc is toxic to bacteria, and 62.5 mg/l will cause a 50 percent drop in the 5-day BOD (ref. 8, p. 296).

pH of the pond was between 7.2 and 10.2 units. The high values resulted from NaOH being used in the process. Cooling water pH varied from 7.8 to 9.8.

TOC concentrations ranged from a high of 550 mg/l to a low of 480 mg/l, with an average of 527 mg/l. Cooling water TOC values averaged

16.8 mg/l. Dissolved solids content of the pond ranged between a high of 18,180 mg/l and a low of 7,480 mg/l, with an average of 15,550 mg/l. These levels for dissolved solids are extremely high. Suspended solids averaged 346 mg/l. Nitrogen concentrations were relatively low. The only distinct nitrogen parameter was TKN: high of 9.5 mg/l, low of 8.2 mg/l, and mean of 9.0 mg/l. Most of the TKN originated as amines and only a trace (average of 0.16 mg/l) was attributed to ammonia. Of the metals analyzed (copper, iron, lead, manganese and zinc), only zinc had concentrations that might impose an immediate threat to water quality. Zinc concentrations ranged from 71.5 mg/l to 69.0 mg/l, with a mean of 69.7 mg/l. Zinc averaged 0.39 mg/l in the cooling water. Treatment should be provided to reduce zinc concentrations to 1.0 mg/l.

Alkalinities ranged from 4,100 mg/l to 1,580 mg/l, with a mean of 2,400 mg/l, which are extremely high alkalinity concentrations. Alkalinity is caused by the presence of hydroxides, carbonates, and bicarbonates usually, and in Alco's case, is resulting from sodium hydroxide or some other caustic. Alkalinity in a stream should be 100-120 mg/l to support diversified aquatic life (ref. 8, p. 129).

Appendix F lists eight specific organic chemicals among a total of 45 to 55 others. Pentachlorophenol is the only compound identified for which adequate toxicity data are known; the treated effluent should contain no more than 0.02 mg/l of "penta" as a maximum (the average should be less). Dibutyl amine and n-butylisothiocyanate should be limited to about the same range because of a bad taste and odor (not shown in the references but noted during laboratory isolation procedures). Toxicity data for the remaining identified compounds will be developed by the EPA

Bioassay Section in Athens, Georgia, and forwarded to the Tennessee Water Quality Control Division and the Region IV EPA Permit Branch as it becomes available.

Because of the large number of potentially toxic compounds present in the waste, Alco should be responsible for determining the toxicity or safety of its waste discharge on a continuous basis. Alco should design a waste treatment plant that will provide an effluent of sufficient quality to support sport fish indigenous to the South Chickamauga Creek-Nickajack waters. New treatment facilities should be designed to circulate a portion of the effluent through a fish tank in which live fish will be maintained. If the fish cannot survive, Alco must provide facilities to hold its waste until sufficient treatment is provided such that they will survive.

Central Soya Company

This plant, located on the east bank of the Tennessee River, produces refined vegetable oil and high protein animal feed from soybeans. The plant area is quite large due to the space requirements for soybean storage and manufacturing processes.

Soybean processing begins with passing the beans through cracking rolls for dehulling. The hulls are ground, fed back into the defatted meal stream and toasted with the meal. The dehulled beans are then cracked, conditioned and flaked. The flakes are then extracted with hexane. The solvent is evaporated, and the flakes are toasted in a desolventizer-toaster. The hexane is recovered, and the oil is separated through a series of oil stripper and condenser units. The oil is refined with sodium hydroxide to remove free fatty acids and then passed through a bleaching unit for shortening oil and is deodorized for salad oil. The meal is cooled, ground, screened and stored. Soap stocks are acidulated, and this acid wastewater must be neutralized prior to discharge.

The first wastewater treatment units are two small sedimentation ponds which are used to remove solids created in neutralizing the acidulation wastes. The effluent from these ponds, along with process wastes from the plant, enters a lagoon aerated with six surface aerators (Figure 7). The effluent passes through a sedimentation unit where the solids are settled for subsequent removal. The effluent line is equipped with an automatic sampling and flow recording system. A second source of plant drainage is a storm drainage system which also receives oil, grease, and other wastes (Figures 8 and 9) from within the plant. This discharge



Figure 7
Central Soya - Aeration Basin

is untreated and mixes with the treated effluent in a common ditch (Figures 8 and 9) where the combined discharges enter the Tennessee River at RM 467.9.

Since June, Central Soya has converted its aerated lagoon and subsequent settling tank to an activated sludge system by providing sludge recirculation. The company has also designed an oil separation system, but approval by state personnel is being withheld pending the clarification of several technicalities. Approval and installation is expected before the company's temporary discharge permit expires on December 8, 1972.

Discussion of Analytical Results

The average flow from the treatment plant during the study was 58.5 gpm (0.084 mgd). The flow through the storm drainage system reflected the heavy rainfall on June 20, with a flow of 368 gpm at the time of sampling. By contrast, the flow remained fairly constant during the next four days, averaging 41.2 gpm with a high and low of 51 and 32 gpm, respectively.

BOD₅ concentrations in the process waste discharge ranged from 3.0 to 10.0 mg/l with a mean loading of 4.0 pounds per day. The BOD₅ concentrations of the storm water ranged from 60 to 180 mg/l, which is considerably higher than normal for storm water. The mean BOD loading from the storm water was 142 pounds per day.

Total phosphorus concentrations were very high in both the plant and storm drainage waters. Phosphoric acid is used within the process and is presently being neutralized and treated with lime. The concentrations in the plant discharge were 79 to 86 mg/l, with a mean of 67.5 mg/l (mean



Figure 8
Central Soya - Storm Water Drainage Ditch and Edge
of Settling Tank

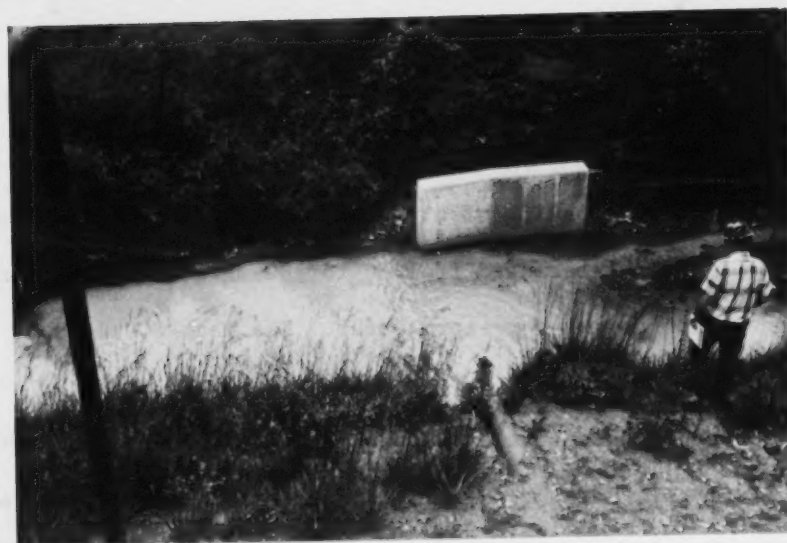


Figure 9
Central Soya - Treated Wastewater Discharge Pipe

loading of 47.4 pounds per day as P). Total phosphorus concentrations in the storm water ranged from 13.5 to 19.6 mg/l, with a mean of 17.2 mg/l.

Nitrogen concentrations were normal for an activated sludge unit treating wastes with high protein content. The TKN, ammonia, and nitrate-nitrite values were in the range of those found in activated sludge effluents of domestic waste treatment plants. TKN concentrations ranged from 7.6 to 11.1 mg/l, with a mean of 8.9 mg/l.

Oil and grease content was 5 mg/l or less in the treated discharge, but ranged from 5 to 120 mg/l in the storm water, with a mean of 52.7 mg/l. The weir box on the storm water drainage system was often full of floating grease and oil, with oil marks visible along the sides and down the channel (Figures 10 and 11).

Of the metals analyzed, only iron had noticeable concentrations. They ranged from 0.8 to 1.4 mg/l in the treated process water. The single iron concentration determined in the storm water was 1.07 mg/l.

The process waste discharge, Station 6, had mean total and fecal coliform densities of 2,500,000 and 170,000/100 ml, respectively. Mean total and fecal coliform densities of 1,900,000 and 180,000/100 ml were measured in the storm drainage stream, Station 7. These high densities indicate some fecal contamination either from domestic waste or from wildlife in the immediate plant area.



Figure 10
Central Soya - Storm Water Drainage - Sampling Point 7



Figure 11
Central Soya - Storm Water Drainage -
Sampling Point 7

E. I. DuPont de Nemours and Company

The Chattanooga DuPont plant is a large complex located on the west bank of the Tennessee River. The plant employs approximately 3,000 people in the production of nylon fiber, nylon resin and polyester fiber.

Process water is pumped from Tennessee River at RM 470.0 through the water intake structure (Figure 12) to a water treatment facility within the plant. Samples of the raw water were taken within this facility (designated as Station 18A).

The wastewater treatment facilities include neutralization and sedimentation of ash from boiler sluice water. A separate trickling filter system is used to treat plant domestic waste which is discharged along with industrial wastes to Nickajack Reservoir at Tennessee River Mile 469.9 (Figure 13). The effluent is equipped with a continuous TOC analyzer and a flow recorder at a Parshall flume where samples were collected (Figure 14).

DuPont has begun construction of a \$3,000,000 activated sludge and nitrification treatment system, scheduled for completion in 1974. The nitrification plant will oxidize the added load of ammonia that will result from installation of air pollution control equipment. Discharging nitrates rather than ammonia is necessary to avoid toxic conditions toward fish and to reduce the oxygen demand on the river, but it will not significantly reduce the eutrophication potential of the wastes. Determining the need for final denitrification will require a broader consideration than the data of this report.



Figure 12
DuPont Water Intake Structure



Figure 13
DuPont - Final Ditch to
Tennessee River



Figure 14
DuPont - Discharge Metering Station
Sampling Point 18

Discussion of Analytical Data

The flow during the study period ranged from 2,610 to 12,200 gpm with a mean flow of 8,042 gpm or 11.58 mgd. The mean BOD₅ loading was 1,545 pounds per day.

TOC concentrations ranged from 5 to 11 mg/l, with a mean of 8 mg/l. The mean TOC loading was 773 pounds per day. Both TOC and BOD₅ loadings were high as would be expected in a chemical operation using organic chemicals.

pH control for the wastewater is good, the observed readings ranged between 7.1 and 7.5 with most values being near 7.1.

Other chemical parameters measured were:

	Dissolved Solids	as Nitrogen			as Phosphorus
		NH ₃	TKN	NO ₂ -NO ₃	P
Maximum (mg/l)	205	1.9	2.1	0.64	0.43
Mean (mg/l)	156	1.0	1.3	0.57	0.28
Minimum (mg/l)	119	0.2	0.6	0.52	0.14
Mean Loading (lbs/day)	15,000	96	125	55	27

Metal concentrations were generally low.

Oil and grease concentrations ranged from less than 5 to 8 mg/l. The loading based on 8 mg/l was 770 pounds per day. Most of this oil is used in lubricating fiber.

Mean total and fecal coliform densities of 630 and 60/100 ml, respectively, were measured in the process effluent stream. Indicator densities measured in the intake process water (Station 18A) were essentially the same as those of the final discharge.

DuPont had a nylon salt spill on June 20-21, 1972. Company TOC analyzing equipment recorded 100 mg/l TOC as compared to a normal reading of 10 mg/l. The pollution control monitoring equipment alerted company personnel and allowed them to take much prompter action than would otherwise have been possible.

Farmers Chemical Association, Inc. (FCAI)

Farmers Chemical (Figure 15) is located on the Volunteer Army Reservation near Tyner, Tennessee. The reservation is shared with Imperial Chemicals Industries (ICI), American Division, the Government contractor for TNT production. Farmers Chemical employs approximately 225 people in the production of nitrogen compounds used primarily for agricultural fertilizers. The company also supplies the utilities for ICI's operations. Because of a watershed divide, Volunteer's waste flows west to Harrison Bay on Chickamauga Lake, while Farmer's waste flows east to Friar Branch, a tributary to South Chickamauga Creek.

Process wastes from Farmers Chemical are discharged after treatment to a tributary of Friar Branch. The plant effluent contains waste discharged from the production of ammonia, nitric acid, urea, and ammonium nitrate as well as chromium from boiler and cooling tower blowdown. The waste stream flowing from the plant property had high concentrations of nitrogen and chromium. The company has installed a considerable amount of water pollution control equipment in the past two or three years. An EPA grant to the company included funds for installation and testing of an ion exchange unit for removal of ammonia and nitrate from their waste stream. At the present time, this unit is in operation on an intermittent basis. Testing is underway and results to date have been encouraging. The unit, if successful, will enable the company to drastically reduce nitrogen in the effluent and may permit a complete recycle system. A treatment system has been installed for chromate reduction and settling of the resulting chromic hydroxide. Wastewater from the plant flows through two ponds before



Figure 15
Farmers Chemical Association, Inc. (Volunteer
Army Ammunition Plant on left)

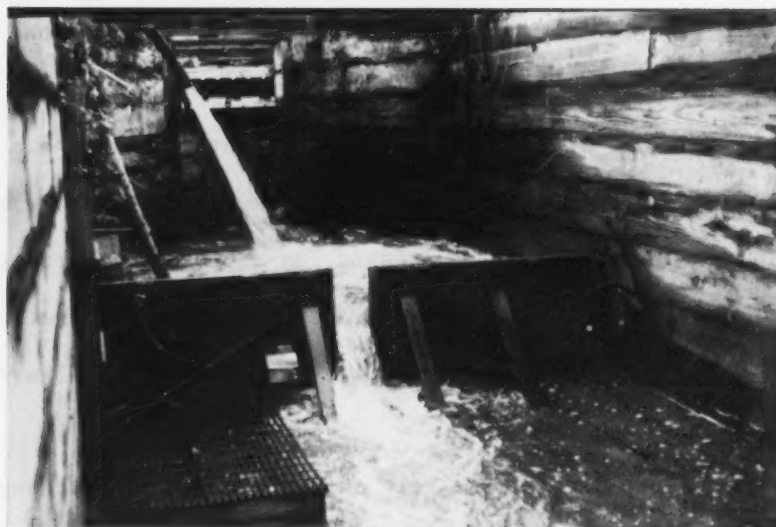


Figure 16
Farmers Chemical Association, Inc. - Final
Discharge - Sampling Point 16

discharge to Friar Branch. These ponds are used primarily for regulation of discharge, and they give the company the capability of containing a spill if it should occur. Previously, Farmers Chemical operated a small trickling filter sewage treatment plant to treat domestic waste for ICI. This treated waste flowed through the common discharge point (Figure 16) before reaching Friar Branch. This treatment plant has been abandoned and now all waste from the ammunition plant flows northwest to Chickamauga Lake.

The company continuously records the flow and collects daily samples with a Sigmamotor Compositing Sampler from the pond discharge just upstream of the Bonny Oaks Drive culvert that leads to Friar Branch. All EPA samples and flow information were obtained using company equipment. The final discharge, the sampling equipment and flow recorder, and the dam across the lake are shown in Figures 16, 17, and 18. Flow varied from 660 gpm to 1720 gpm with a mean of 977 gpm, used to calculate the loadings discussed below.

The analytical results show a very large quantity of ammonia (61 mg/l average), total Kjeldahl nitrogen (83 mg/l average), and nitrite and nitrate (83 mg/l average) — all expressed "as nitrogen." Corresponding pounds per day are shown below. The average chromium concentration was greater than 0.10 mg/l (1.2 pounds per day) but less than 0.13 mg/l (1.5 pounds per day).

During the week these samples were collected, the ion exchange unit was frequently producing an effluent containing less than 10 mg/l total nitrogen (the design target is 3 mg/l). These observations suggest that considerable time may be required to exhaust the excess nitrogen supply

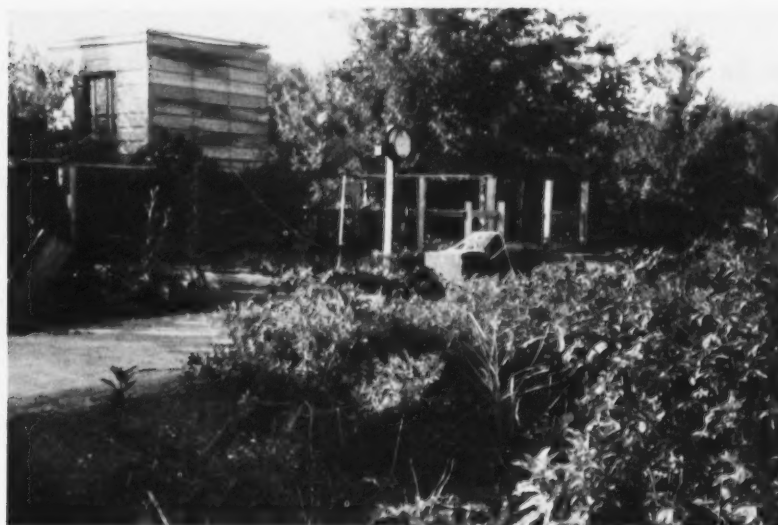


Figure 17
Farmers Chemical Association, Inc. - Sampling Equipment
Over Final Discharge - Sampling Point 16



Figure 18
Farmers Chemical Association, Inc. -
Final Polishing Pond

stored in the drainage basin. The same reasoning may also apply to chromium.

Although these nitrogen values are high, they are below those determined during the October 1968 FWPCA study at the same sampling point as shown below:

NITROGEN IN FCAI EFFLUENT

	<u>NH₃-N</u>	<u>Kjeldahl-N</u>	<u>(NO₂-NO₃)-N</u>
1968 lbs/day	994	1448	1320
1972 lbs/day	<u>722</u>	<u>975</u>	<u>975</u>
Reduction since 1968	27.5%	32.6%	26.2%

Mean total and fecal coliform densities, as measured at Station 16, were 1800 and 790/100 ml, respectively.

GAF Corporation

The GAF plant at 2120 Polymer Road manufactures styrene-butadiene latex rubber. Its sister plant immediately to the west along Polymer Road uses latex, natural rubber, and additives to make blends of rubbers. The wastewater from both operations is pumped to the treatment facilities at 2120 Polymer Road.

The latex wastewater is cooled through a barometric condenser; coagulated with calcium chloride; and settled through an indoor, concentric flow clarifier. Outside the plant it is aerated through a 1 1/3-acre pond with two floating aerators, and discharged through a 90° V-notch weir (Figure 19). In the discharge ditch it flows west about 50 yards (Figure 20) to Friar Branch, 0.6 miles upstream from South Chickamauga Creek. Discharge from a steam line at the head end of the aeration basin heats the wastewater to achieve better coagulation and treatment. During the EPA reconnaissance on May 23, 1972, GAF's discharge was extremely white and turbid, but during the survey in June it was much clearer and during the biological follow-up survey in August it was very clear.

Inherent problems related to latex manufacturing become evident in the wastewater at GAF; namely, highly turbid (milky) mixture of soap solution, coagulated rubber and inorganic salts. From time to time, batches of improperly polymerized rubber must be dumped into the wastewater system. Even though this wasted latex is placed in a separate pond (Figure 21), the decanted liquid passes through the aerated lagoon (Figures 21 and 22) and exerts an additional load on the treatment system. Ammonia which is used in the production of latex is partially wasted from the processes



Figure 19
GAF - Treated Wastewater Discharge - Sampling Point 15



Figure 20
GAF - Final Discharge Ditch to
Friar Branch



Figure 21
GAF - Aeration Basin and Settled Latex Holding Basin



Figure 22
GAF - Foam on Aeration Basin

and presents a major treatment problem. The effluent loadings of ammonia from GAF were very high. The total dissolved solids load originates from the use of calcium chloride as a coagulating agent for wastewater treatment as well as from inorganic salts and emulsifiers used in the manufacture of latex. Although not measured during the 1972 EPA study, chlorides may constitute a high proportion of the dissolved solids load.

GAF has attempted to have its treated wastewater accepted into the city sewers leading to the Brainard Sewage Treatment Plant. Unfortunately, the Brainard plant could not take the added hydraulic load. Negotiations are now in progress to have it diverted to the new Moccasin Bend Sewage Treatment Plant. If these negotiations fail, GAF has committed itself verbally to install a final clarifier pond.

Discussion of Analytical Data

Biochemical Oxygen Demand (BOD₅) concentrations ranged from 14 mg/l to 40 mg/l with a mean of 26.5 mg/l. The average BOD₅ loading discharged to Friar Branch was 87.9 pounds per day.

Ammonia nitrogen and total Kjeldahl nitrogen (TKN) mean concentrations were 106.2 and 104.2 mg/l, respectively. Because the values for ammonia and TKN are nearly the same, it is evident that the nitrogen present is primarily ammonia. GAF discharged an average of approximately 352 pounds per day to Friar Branch during the study.

Total dissolved solids were high, ranging from 2620 to 4330 mg/l, with a mean of 3660 mg/l, approximately 12,000 pounds per day.

The following parameters were found in insufficient concentrations to be detrimental to water quality: total organic carbon (TOC), chromium,

copper, zinc, manganese, iron, lead, aluminum, nitrite-nitrate nitrogen, and phosphorus.

Hill's Hosiery Mill

This one-building mill in Daisy, Tennessee, is a dyeing operation for children's and men's socks. It is owned and managed by Mr. Hill and operated by about 35 employees. On May 24, 1972, during the reconnaissance for this survey, the company was discharging a small volume of concentrated red dye waste to a ditch (shown in the two close-up photographs -- Figures 23 and 24) along the road in front of the building. The waste flowed across several residential front yards and finally reached Poe Branch, a tributary to North Chickamauga Creek. In the original color print of Figure 25, the red dye waste can be seen entering Poe Branch (just below the center of the photograph) and hugging the upper bank as it moves downstream to the left.

On June 8, 1972, Mr. Hill was notified by letter of the forthcoming EPA waste source survey (see Appendix G). During the survey on the week of June 19, 1972, there was no discharge to the road ditch and we were unable to determine if there was a discharge elsewhere. Therefore, no samples were obtained.



Figure 23
Hill's Hosiery Mill - Ditch
in Front of Plant



Figure 24
Hill's Hosiery Mill - Ditch
Approaching Poe Branch



Figure 25
Poe Branch at Confluence with Ditch
From Hill's Hosiery Mill
Sampling Point 20A

Mueller Company

This plant discharges wastewater into South Chickamauga Creek at RM 1.2. Mueller is a major manufacturer of fire hydrants and valves and employs approximately 1,000 people. The company separately discharges domestic wastewater and process wastewater. The domestic discharge passes through activated sludge treatment and subsequent chlorination (Figure 26) prior to discharge. This treatment unit appeared to be in good operating order. (At the time of the EPA study, the company reported that a break in a water line had caused considerable water infiltration into the domestic treatment system.)

Process wastewater (Figure 27) is treated alternately through each of two parallel sedimentation basins. While one basin is being filled, the other is decanted, and the solids are removed. There is a common discharge channel from the basins where a flow measuring weir had been installed. Sediment and undergrowth had filled the channel, and the weir had rusted away. The average flow during the study of 37 gpm was measured over a separate weir installed by EPA in the discharge ditch leading to South Chickamauga Creek. The overall appearance of the process waste treatment facility was one of neglect. The wastewater being discharged was turbid, black in color with visible oil and fine sediments present.

The foundry works contribute a heavy load of solids and oils to the process wastewater from casting operations. Because the plant uses electric furnaces, the pollution load from air scrubbers is not as high as similar operations using coke as fuel.



Figure 26
Mueller - Domestic Waste Chlorine Contact Chamber -
Sampling Point 11



Figure 27
Mueller - Industrial Waste Settling Basin

Discussion of Analytical Data

BOD₅ values from the industrial discharge were low, averaging 10.6 mg/l with a loading of 4.69 pounds per day. The BOD₅ concentrations in the sanitary discharge varied from 6.0 mg/l to 74 mg/l with an average of 33 mg/l. Normal, well-operated activated sludge BOD effluent concentrations fall between 10-20 mg/l.

pH values ranged from 6.5 to 8.2. Observed values on the domestic discharge ran from 6.3-7.2. Nutrient levels for the domestic waste were values normally found for activated sludge effluents. TKN averaged 13.4 mg/l, ammonia 2.36 mg/l, nitrite-nitrate nitrogen 0.436 mg/l, and total phosphorus 1.818 mg/l. Oil and grease concentrations were 5 mg/l (the detection limit of the analytical procedure) or less.

Iron concentrations ranged from 2.0 to 4.8 mg/l, with an average of 3.8 mg/l, a loading of 1.67 pounds of iron per day. As the pH increases in the receiving stream, iron will begin to precipitate and settle. These averages exceed the recommended concentrations of water to be used for industrial or domestic use (1 mg/l), but they are within the range (3-5 mg/l) normally required of a good effluent.

Phenols increased steadily during the survey period from a low of 0.043 mg/l to a high of 7.96 mg/l, with a mean of 2.42 mg/l. These values are very high and represent a significant pollutional problem. The loading averaged 1.07 pounds per day. Dissolved solids, TOC, and metals (copper, lead, manganese, zinc) were found in insufficient concentrations to cause any immediate water quality deterioration.

Polysar Latex

The information reported here was provided by the Tennessee Water Quality Control Board's Chattanooga Office personnel. It is included because of the past association of Polysar Latex's discharges with taste and odor problems in the Chattanooga water supply system.

Polysar Latex has the physical option available to discharge process wastewater either to the Tennessee River through a submerged outfall or to the city sewers. However, according to monthly reports submitted by the company to state officials, all process wastewater since the first two weeks of start-up in late August and early September 1971, has gone directly to city sewers.

The company has a pre-treatment system, but it has not been able to meet state effluent requirements of 1 mg/l styrene as well as a total dissolved solids limitation which is sometimes exceeded when too much calcium chloride is added to precipitate latex. State personnel believe the company would choose to discharge to the river if the effluent was of sufficient quality.

Cooling water is discharged to the Tennessee River, but no adverse effects are believed to be attributed to this.

When the plant first began operation, it had a spill of about 70 gallons of diesel fuel which just preceded a taste and odor problem in the city water supply system. A styrene spill occurred two weeks later, but no taste and odor problem resulted from this second spill.

Seaboard Allied Milling Corporation

This mill, located on the south bank of the Tennessee River, processes feed grains into flour and livestock feeds. The waste results from wash-water discharged over a slurry of spilled feed and flour. In addition, surface runoff during rains washes flour spilled on the ground into a common drainage ditch with the plant effluent. The wastewater flow in this ditch is small (average of 10 gpm during study), untreated and very foul smelling. This waste enters the Tennessee River at RM 467.7. A second drainage ditch on the southeast side of the mill, originates at a cargo tank-wash station. This waste runs parallel to the river and discharges to a large field where it either leaches into the ground or evaporates. Only the discharge to the river was sampled during the EPA study.

Discussion of Analytical Data

Observed BOD₅ concentrations were high, ranging from a high of 3500 mg/l to a low of 900 mg/l, with a mean of 1675 mg/l. The high flow recorded during the study was 30 gpm with a corresponding BOD₅ concentration of 1000 mg/l and a loading of 360 pounds per day. On the other hand, the low flow measured was 1 gpm with a BOD₅ concentration of 3500 mg/l and a loading of 40.6 pounds per day.

pH of the waste was low, with most values falling around 5.0. Observed values ranged between 4.6 and 6.2.

In conjunction with the low pH values, certain metal concentrations were high. Among those showing high values was iron which ranged from 2.0 to 26.3 mg/l. One concentration of manganese was observed at 1.8 mg/l while the other four values ranged from 0.13 to 0.70 mg/l.

As expected, TOC values were high, ranging from 85 to 1750 mg/l, with a mean of 770 mg/l.

Mean total and fecal coliform densities were 140,000 and 78,000/100 ml, respectively.

Southern Railway System

Southern Railway operates a major servicing and switching yard northeast of downtown Chattanooga. Locomotives and rail cars are cleaned and serviced, producing a waste containing lubricating oil, fuel oil, solvents, and detergents. Normally the waste is collected and passed through an oil separation system (Figures 28 and 29) before discharge to Citico Creek. However, during periods of heavy rains the treatment facility is overloaded from surface runoff and heavy loads of raw oil bypass the treatment unit. Treatment consists of grit removal and gravity oil separation followed by an air flotation unit using polyelectrolyte as a flocculant and final clarification. Chlorination is used for oxidation of phenols. There are at least three storm drains discharging surface runoff and other unknown wastes to Citico Creek. At least one of the drains carries untreated domestic waste. There are a few small waste discharges to Citico Creek above Southern Railway Yards; however, the treated and untreated wastes from the yards are the principal source of pollutants in the stream. The water quality of Citico Creek is critical since it intersects the Tennessee River (Nickajack Lake) immediately downstream from the Chattanooga water intake. During periods of low flow and backflow in Nickajack Lake, the heavily polluted water of Citico Creek may be taken into the waterworks intake.

During the heavy rainstorm on June 20, 1972, the 56-inch pipes at Stations 2 and 3 flowed almost full of contaminated runoff, whereas during the reconnaissance on May 23, 1972, the weather was dry and flows were small (practically negligible at both Stations 2 and 3).



Figure 28

Southern Railway - API Oil Separator

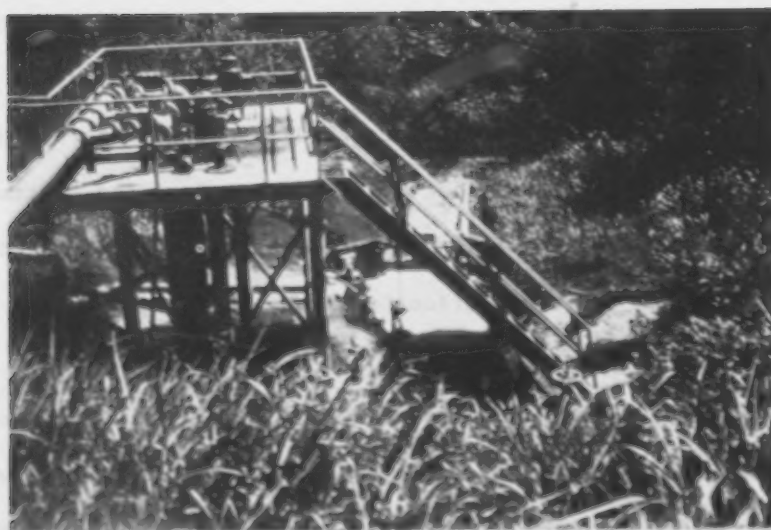


Figure 29

Southern Railway - Collection Pumps With Discharge
Point in Background

Discussion of Analytical Data

The treated wastewater flow during the EPA study (Station 1) ranged from a high of 476 gpm on June 20 to a normal flow of 276 gpm for the remainder of the study. The mean flow was 326 gpm or 0.469 mgd. The high flow on June 20 reflects the amount of storm water passed through the plant.

BOD₅ concentrations ranged from 24 to 120 mg/l, with a mean of 53 mg/l. The mean loading was 207 pounds per day.

TOC values ranged from 30 to 120 mg/l, with a mean of 54.4 mg/l. The mean TOC loading was 213 pounds per day.

Oil and grease concentrations varied greatly from less than 5 to 150 mg/l. The mean concentration was 44.3 mg/l. During the heavy rain on June 20, the high concentration of 150 mg/l was observed, and during that period 860 pounds per day of oil and grease was discharged. An average of 33 pounds per day was discharged during the remainder of the study.

Phenolic concentrations ranged from 0.017 to 0.040 mg/l, with a mean of 0.025 mg/l. The phenolic level in the discharge was being reduced by chlorination which would also oxidize other organic compounds present. The BOD₅ concentrations may be reflecting the effects of chlorine by both chemical oxidation and inhibition of bacteria.

Total iron concentrations ranged from 0.9 to 2.2 mg/l, with a mean of 4.7 pounds per day. Iron was the only metal found in quantities that might affect water quality criteria.

Total nitrogen concentrations were low; the TKN mean concentration was 2.76 mg/l.

Methylene Blue active substances (primarily detergents) ranged from 1.2 to 5.4 mg/l, with a mean of 2.9 mg/l. Foaming was noticeable in the effluent at each visit to the treatment plant (Figures 30 and 31).

Mean total and fecal coliform densities of the treated wastewater were low due to chlorination. Mean densities of <20/100 ml were measured for both total and fecal coliforms.

Station 2 which empties into Citico Creek is a storm drain discharging undetermined amounts of industrial and domestic wastes. Station 3 is located upstream from Station 2 and discharges yard drainage into Citico Creek (Figure 32).

The flows for Station 2 measured for four days after the storm reflected the runoff from the yard, ranging from 7 to 90 gpm while Station 3, which was also not measured at the time of maximum flow, showed a marked reduction in flow at the end of the study (120 and 66 gpm on the third and fourth days after the storm). Flows at both stations were far too great to measure during the storm.

Station 2 had noticeably high BOD₅ concentrations ranging from 6.0 to 72.0 mg/l, with a mean of 31.5 mg/l. Station 3 had one concentration of 4 mg/l and three values or less than 26 mg/l.

Both Stations 2 and 3 had high concentrations of oil and grease with a visible sheen present at each sampling period. Concentrations at Station 2 ranged from 16 to 360 mg/l with a mean of 110 mg/l. The one high concentration was collected at a period of low flow and represents a slug effect for oil and grease. Station 3 oil and grease concentrations ranged from 12.0 to 32.0 mg/l, with a mean of 21.8 mg/l.



Figure 30
Southern Railway - Discharge Flume - Sampling Point 1



Figure 31
Southern Railway - Tributary to Citico Creek Immediately
Below Main Outfall



Figure 32

Citico Creek - Sampling Points 3 and C-2A

Iron concentrations were high in both Stations 2 and 3, with mean concentrations of 1.05 and 0.6 mg/l, respectively.

Stations 2 and 3 had high total and fecal coliform densities indicating domestic waste discharges. Station 2 had a mean total and fecal coliform density of 2,600,000 and 150,000/100 ml, respectively. Station 3 had a mean total and fecal coliform density of 31,000 and 11,000/100 ml, respectively.

Further discussion pertinent to the effects of Southern's discharge is found under "Citico Creek" in the section on "STREAM DATA AND OBSERVATIONS."

Tech Finishing

Tech Finishing is a small plating company on the bank of an unnamed tributary to Citico Creek. It is located on Latta Street near Riverside Drive just past the west side of Southern Railway's property. According to an employee, waste is pumped to a storage tank then trucked to another location for treatment. However, there is considerable evidence of plating waste discharges in the not-too-distant past. Several drums of "Unichrome" in the plant indicate that large quantities of chromium are being used.

At Station CR-3, approximately 75 yards upstream from the plant effluent, total chromium was less than 0.05 mg/l. At Station CR-2, immediately downstream from Tech Finishing where the culvert goes under Latta Street, total chromium measured 0.13 mg/l; and 50 yards farther downstream at Station CR-1 chromium measured 0.35 mg/l.

As a minimum, a letter from the company committing it to continued hauling of wastes to a treatment facility and to contain all spills may be appropriate.

Tennessee Finishing & Dyeing

This Daisy, Tennessee, cloth dyeing company employs from 75 to 125 people. Untreated wastewater (Figures 33 and 34) is discharged to a side ditch which flows into Poe Branch and eventually into North Chickamauga Creek. Material is brought in bolts, dyed and then shipped out again. No information was available as to how many process steps were involved and what chemical discharges could be expected. The plant operates on a 12-15 hour day usually 5 days a week depending on the amount of work to be done.

Discussion of Analytical Data

Flows were spasmodic, from 6 to 113 gpm. The low flow of 6 gpm was measured on Saturday during a period when only washwater was flowing from the plant.

As would be expected in a textile finishing operation, BOD₅ concentrations were very high. The range was 340 to 840 mg/l (disregarding a 14.0 value which corresponded to the low flow).

TOC concentrations ranged from 63 to 680 mg/l and averaged 468 mg/l (disregarding a low of 8 mg/l recorded on the day of low flow).

pH observations varied from 4.5 to 9.1 with most values being around 6.3.

Nitrogen values were high with ammonia concentrations ranging from 0.8 to 40 mg/l. Disregarding the low value found on the day of the low flow, a mean of 19.4 mg/l of ammonia was found.

TKN concentrations ranged from 3.8 to 48.0 mg/l, with a mean of 23.0 mg/l.



Figure 33
Tennessee Finishing and Dyeing - Temporary Flow Measuring
Weir Installed in Roadside Ditch - Sampling Point 20



Figure 34
Tennessee Finishing and Dyeing - Main
Outfall

Nitrite-nitrate values ranged from 0.29 to 14.8 mg/l, with a mean concentration of 4.35 mg/l.

Phosphorus concentrations averaged 1.71 mg/l, with one reading of 2.12 mg/l.

Oil and grease concentrations ranged from 34 to 180 mg/l, with a mean of 75 mg/l. High concentrations of oil are commonly discharged from finishing plants.

No concentrations of chromium were found in the water samples, which indicates that no chromate dyeing is used, or at least not during the study.

Phenolics ranged from 0.152 to 2.77 mg/l, with a mean of 0.912 mg/l. Phenolics are indicative of synthetic fiber dyeing.

Volunteer Army Ammunition Plant

This facility is operated by Imperial Chemical Industrial (ICI), American Division, under government contract to the U. S. Army. Trinitrotoluene (TNT) is produced for munitions use by the U. S. military. Sulfuric and nitric acids are produced at the plant and reacted with toluene to form TNT. The process waste is discharged to a small stream flowing north off of the reservation to an arm of Chickamauga Lake called Waconda Bay.

The contractor collects daily samples from the large pond outflow (Figures 35 and 36) west of Highway 58 through a Technicon "Proportioning Pump" (also used to collect EPA samples). All EPA flow measurements were made by calibrating a staff gage from current meter flow determinations. Imperial Chemical Industries made no flow measurements, although plans were being made to install a measuring flume.

The color photographs, from which Figures 35 and 36 were taken, show the very pronounced brownish red color of the discharge, presumably from "nitro bodies" characteristic of TNT wastes. Average discharged amounts of nitrogen during the study and the amounts indicated on the Corps of Engineers permit applications (4-15-72) were:



Figure 35
Volunteer - Final Pond Discharge



Figure 36
Volunteer - Stream Receiving Final
Pond Discharge - Sampling Point 17

	EPA Measured	COE Permit Application Information		
		Original (existing)	Revised*	Revised**
NH ₃ -N, lbs/day	128	190	25	0.66
Kjeldahl-N, lbs/day	302	190	50	—
NO ₂ -NO ₃ -N, lbs/day	1,852	1,707	602	33
BOD ₅ , lbs/day	1,640	571	150	99
Total solids, lbs/day	99,800	87,332	23,066	—
Suspended solids, lbs/day	11,000	3,996	1,055	165
Total phosphorus, as P, lbs/day	76.8	26	2.5	3.3
TOC	1,530	—	—	—
Total iron, lbs/day	565	46	10.2	2
Total manganese, lbs/day	43.7	8.8	0.15	0.33
Total zinc, lbs/day	0.23	—	—	—
Flow/ mgd	28.2	22.6	6.022	0.792

* Projections based on operation of new process lines and waste treatment facilities to be on stream by January 1, 1973 (tentative).

** Projections based on operation of new process lines and waste treatment facilities to be on stream by July 1, 1973 (tentative).

Volunteer's waste should improve considerably as the entire plant completes a modernization program now well underway. Portions of this program affecting pollution abatement are:

1. First three of ten TNT lines scheduled for completion in June 1973.
2. Sulfuric Acid Regeneration Plant (SAR) scheduled for completion in September 1973.
3. Ammonia Oxidation Plant (AOP) - August 1972.
4. Direct Strong Nitric Acid Plant (DSN) - October 1972.
5. Second three of ten TNT lines - Est. January 1974.
6. Second New Acid Plant (SAR-2) - FY-74 - not funded.
7. Last four of ten TNT lines - September 1975.
8. New Red Water Plant - July 1976.
9. Industrial Waste Treatment - Est. September 1973.

Sanitary wastes, previously discharged to a sewage treatment plant that drained into Farmers Chemical wastewater, are now reportedly discharged to septic tanks and tile drainage fields. Total and fecal coliform means, 270 and 50 MPN per 100 ml, indicate that these wastes are not contaminating the process wastes.

W. R. Grace Chemical Company

This plant, located on the south bank of South Chickamauga Creek, extracts rare earth chemicals from monazite sand, a thorium-rare earth orthophosphate. Cerium comprises 45% of the product, although a total of 14 rare earth elements could be present. The ore is extracted with sodium hydroxide which converts the rare earth phosphates to hydroxides. The by-product trisodium phosphate is decanted and pumped to a phosphate-holding pond (Figure 37). The rare earth hydroxides are treated with hydrochloric acid under controlled conditions to separate the thorium as hydrous thorium oxide, and a solution of rare earth chlorides. The chloride solution contains cerium in the +3 state and a product containing 90% of cerium is obtained by oxidizing the cerium to the +4 state. Hydrofluoric acid is sometimes used (though not recently), and the resultant wastewater is neutralized in a small holding pond (Figure 38). When this pond overflows, it discharges to the dump leachate stream.

The wastewater treatment system consists of three ponds, two holding ponds and a discharge pond. The phosphate pond between the dump and the road receives trisodium phosphate from a caustic recovery unit, and the thorium wastes are segregated and placed in the thorium pond. The company is holding both these materials for later product recovery. The only pond with a discharge (other than the small hydrofluoric acid neutralization pond) is the combination pond which had an average flow of 0.256 mgd (0.397 cfs) during the EPA study. Plant domestic waste from a stirred septic tank is also discharged to this pond. The effluent from this pond discharges to South Chickamauga Creek. Another source of wastewater sampled during the study was the leachate originating from within



Figure 37
W. R. Grace - Phosphate Holding Pond



Figure 38
W. R. Grace - Fluoride Holding and Neutralization Pond



Figure 39
W. R. Grace - Landfill



Figure 40
W. R. Grace - Leachate Sampling Point -
Sampling Point 13

the landfill area (Figures 39 and 40). This landfill contains a variety of materials which includes radioactive residue that has undergone acid treatment during processing. This stream also discharges to South Chickamauga Creek.

Discussion of Analytical Data

The wastewater discharge (Figure 41) from the combination pond was clear with a high pH. Observed pH values ranged from 9.6 to 11.8. The hydroxyl content of the water was high enough to impart a "slippery" feel to the water. The pH from the leachate stream was very acid, with one reading less than 2.0. The highest reading was 6.2 due to the dilution from heavy rains.

Phosphorus concentrations in the main pond discharge ranged from 54 to 204 mg/l, with a mean of 103 mg/l in the main effluent. The loading was 220 pounds per day. Phosphorus levels in the leachate stream were relatively low, ranging from 0.1 to 2.5 mg/l, with a mean of 0.7 mg/l. Nitrogen values were relatively low in the main effluent, but some higher observations were noted in the leachate. TKN concentrations in the leachate ranged from 2.2 to 10.0 mg/l, with a mean of 5.6 mg/l; the mean ammonia value was 5.3 mg/l.

As would be expected in highly-alkaline waters, no metal concentrations of concern to water quality criteria were found. On the other hand, high levels of iron ranging from 38 to 50 mg/l, and manganese from 19 to 42 mg/l were found in the leachate. Although the flow from the landfill area is low (7-65 gpm during the study) and very subject to runoff influences, it still is a very concentrated waste.



Figure 41
Treated Waste Outfall - Sampling Point 12
W. R. Grace

TABLE II
RADIOACTIVITY RESULTS (W. R. GRACE) AND EXPOSURE GUIDELINES

	Sampling Dates				Dump Leachate				Drinking Water	Guidelines		
	6/21/72	6/22/72	6/23/72	6/23/72	6/21/72	6/22/72	6/23/72	6/23/72		Range I*	Range II*	Range III*
Undissolved Solids mg/l												
Gross Alpha pc/l	43	97	72		68	59		55		0-2	2-20	20-200
Gross Beta pc/l	63	202	56		7	16		19	1,000***			
	123	60	86		20	14		12				
Dissolved Solids mg/l												
Gross Alpha pc/l	2,100	4,400	7,000		2,200	2,000		1,700		0-2	2-20	20-200
Gross Beta pc/l	77	44	177		391	172		143	1,000***			
	20	64	58		752	510		396				
Total Simple Gamma Activity												
137Cs pc/l	10	30	30		30	20		--				200,000
214Bi pc/l	340	610	580		60	90		110				400,000
144Ce pc/l								170				100,000
Results of Specific Alpha Analyses												
234U pc/l	60	89	167		10	6		4				300,000
230Th pc/l	60	90	169		10	6		5				400,000
228Th pc/l	0.9	1.0	0.6		29	21		14				70,000
230Th pc/l	0.1	0.1	0.2		0.6	0.7		0.5				20,000
232Th pc/l	0.2	0.05	0		0.7	0.8		0.9				20,000
226Ra pc/l	0.5	0.4	0.3		117	79		61	3	0-2	2-20	100

* Range I -- Periodic surveillance as necessary.

** Range II -- Quantitative surveillance and routine control.

*** Range III -- Evaluation and application of additional control measures as necessary to reduce levels to Range II or lower and provide stability at lower levels.

** Maximum permissible concentrations in water for occupational exposure. These limits must be reduced ten-fold for water that flows past the controlled plant area to areas accessible to the public.

*** In the absence of Alpha emitters and Strontium-90. If exceeded, the specific radio nuclides present must be identified. This is a total maximum, not a separate maximum for different components.

Alkalinities in the main effluent ranged from 1580 to 4100 mg/l as CaCO_3 , with a mean of 2400 mg/l. Although high alkalinities have little sanitary significance, they do affect fish and aquatic life habitation.

Fluoride concentrations ranged from 11.4 to 5.3 mg/l in the main effluent with a mean concentration of 7.2. Concentrations in the dump leachate ranged from 13 to 5.9 mg/l with a mean concentration of 9.2 mg/l. Mean concentrations at both stations were well above drinking water standards of 1.5 mg/l on each day sampled. However, even the minimum flow of record in South Chickamauga Creek (61 cfs) provides more than a 150-fold dilution. (The seven-day, ten-year low flow of 84 cfs provides more than a 200-fold dilution.) Since 1.2 mg/l fluoride is desirable in water supplies, no fluoride restriction should be placed on this limited discharge.

Radioactivity

Radioactivity data shown in Table 2 show no problem, even based on drinking water and occupational standards, except for radium in dump leachate. This dump should be closed either by hauling the material away or by using proper sanitary landfill closing practices, which would probably bring the radium discharge to acceptable levels.

A permit for discharge from the process water lagoon should contain the general requirement that the company take all practicable steps to minimize radioactivity in its discharge and that the company notify the permit-issuing regulatory agency if there is reason to believe that the levels reported here are being consistently exceeded.

Rare Earths

The toxicity of the rare earth elements is extremely variable from one species to another. Toxicities to aquatic organisms are shown in Table 3.

Chemical properties of the rare earths are quite similar; and the acute toxicities to test mammals shown in Table 4 appear similar enough to obviate the need for requiring different effluent limits for the various elements. The most toxic oral dose was the lower limit of about 2000 mg/kg of neodymium nitrate administered to a female rat. Haley (10), from whose article Table 4 was taken, concluded:

"These elements have a low to moderate acute toxicity rating and cause very little change in animals when fed for several months. The most striking effects produced by these compounds are the induction of both skin and lung granulomas after local injection and inhalation."

These data suggest that the effects of these rare earth elements in W. R. Grace's discharge would have no significant effect on the downstream water supply.

The effects of rare earths on the aquatic food chain are more critical both because of acute toxicity (as to Scenedesmus) and because of accumulation by many forms of aquatic life as shown in Table 5.

The high pH (9.6 to 11.8) of the effluent from W. R. Grace is very desirable in limiting the release of the rare earths. The statement in Water Quality Criteria (8) for cerium probably applies similarly to the other rare earths:

TABLE 3 (Ref. 8)

TOXICITIES OF RARE EARTHS TO AQUATIC ORGANISMS

<u>Chemical</u>	<u>Species</u>	<u>Toxic Concentration</u>	<u>Remarks</u>
Cerous chloride	<u>Orizias</u> (a small, mature freshwater fish)	190 mg/l	lethal limit
"	<u>Scenedesmus</u> (a green alga)	0.15-0.20 mg/l as cerium	toxic threshold
"	<u>E. coli</u> (a bacterium)	0.75-1.5 mg/l as cerium	"
"	<u>Daphnia</u> (water flea)	1,000 mg/l	no effect
Cerous sulfate	<u>Scenedesmus</u>	0.14 mg/l	toxic threshold
"	<u>Daphnia</u>	1,000 mg/l	no effect
Cerous fluoride	<u>Tinea vulgaris</u> (a fish)	30,000 mg/l	48-hr. lethal dose
Thorium chloride	<u>Orizias</u>	18 mg/l	24 hrs. in only 20 ml test solution
Thorium nitrate	<u>Scenedesmus</u>	0.4-0.8 mg/l as thorium	median threshold effect
"	<u>E. coli</u>	0.8 mg/l	median toxic level
"	<u>Microregma</u> (a protozoan)	25 mg/l	deleterious
"	<u>Daphnia</u>	1,000 mg/l	no effect

TABLE 4
ACUTE LETHAL DOSES OF THE RARE EARTHS (10)

Chemical	Species and Sex	I.D. ₅₀ , mg./Kg.	Adm. Rt. ^a
Scandium chloride	Mouse ♂	755(741.7-768.6)	i.p.
	Mouse ♂	4000(3960-4040)	P.O.
Yttrium chloride	Mouse	88(67.7-114.4)	i.p.
	Rat	450	i.p.
nitrate	Rat	45(41.1-49.3)	i.p.
	Frog	350*	s.c.
	Mouse	1600	s.c.
	Rat	20-30*	i.v.
	Rat	350	i.p.
	Rabbit	500	i.v.
	Rat	500	i.p.
oxide	Rat	500	i.p.
	Rat	500	i.p.
Lanthanum acetate	Rat	10,000	P.O.
	Rat	475	i.p.
ammonium nitrate	Rat	3400	P.O.
	Rat	625	i.p.
citrate chloride	Mouse	78.2(70.0-100.3)	i.p.
	Guinea pig	60.7(17.7-207.0)	i.p.
chloride	Frog	about 1000*	s.c.
	Mouse	3500*	s.c.
	Mouse	3500*	s.c.
	Mouse	372.4(323.6-428.5)	i.p.
	Mouse	>500*	s.c.
	Mouse	>160*	i.p.
	Rat	106(91.4-123)	i.p.
	Rat	350	i.p.
	Guinea pig	129.7(105.4-159.6)	i.p.
	Rat	4200	P.O.
	Rabbit	200-250*	i.v.
nitrate	Rat	4500	P.O.
	Rat	450	i.p.
oxide	Mouse ♀	410(353-475)	i.p.
	Rat	>10,000	P.O.
sulfate	Rat	>5000	P.O.
	Rat	275	i.p.
Cerium chloride	Frog	about 300*	s.c.
	Mouse	5000-10,000*	s.c.
	Mouse	353.2(206.5-420.7)	i.p.
	Rat	2000-4000*	s.c.
	Rat	50-60*	i.v.
	Guinea pig	55.7(40.1-77.4)	i.p.
	Rat	146.6(128.6-167.1)	i.p.
	Guinea pig	103.5(73.1-146.5)	i.p.
citrate chloride	Guinea pig	470(435-508)	i.p.
	Mouse ♀	200(238-354)	i.p.
	Rat ♀	4200(3684-4788)	P.O.
	Rat ♀	4.3(3.4-5.6)	i.v.
	Rat ♂	49.6(32.8-74.4)	i.v.
Praseodymium chloride	Frog	about 1000-1500*	s.c.
	Mouse	2500*	s.c.
	Mouse	358.9(297.2-433.5)	i.p.
	Mouse	900-1500*	s.c.
	Mouse ♂	600(552-652)	i.p.
	Mouse ♂	4500(4054-4995)	P.O.
	Rat	<2000	i.p.
	Guinea pig	125(78.2-200)	i.p.
	Rabbit	200-250	s.c.
	Mouse	140.6(126.2-156.7)	i.p.
	Guinea pig	53(29.9-70.3)	i.p.
nitrate	Mouse ♀	200(259-325)	i.p.
	Rat ♀	245(209-287)	i.p.
	Rat ♀	3500(3017-4060)	P.O.
	Rat ♀	7.4(5.1-10.8)	i.v.
	Rat ♂	77.2(49.7-119.8)	i.v.
	Rat	10.8-13.9*	i.v.
Neodymium chloride	Frog	250*	s.c.
	Mouse	4000*	s.c.
	Mouse ♂	600(562.0-640)	i.p.
	Mouse ♂	5250(4730-5830)	P.O.
	Mouse	348.3(297.2-408.3)	i.p.
	Rat	150-250*	i.p.
	Guinea pig	70*	i.v.
	Guinea pig	139.6(99.3-196.3)	i.p.
	Rabbit	200-250*	i.v.

TABLE 4 (cont'd)
ACUTE LETHAL DOSES OF THE RARE EARTHS (10)

Chemical	Species and Sex	L.D. ^a , mg./Kg.	Adm. Rt. ^b
citrate chloride	Mouse	138(94.4-201.8)	i.p.
	Guinea pig	40.5(4.7-348)	i.p.
nitrate	Mouse ♀	270(221-320)	i.p.
	Rat ♀	270(231-316)	i.p.
	Rat ♀	2750(1896-3988)	P.O.
	Rat ♀	6.4(5.5-7.3)	i.v.
	Rat ♂	66.8(53.5-83.6)	i.v.
Samarium chloride	Frog	about 150*	s.c.
	Mouse ♂	585(508.7-672.7)	i.p.
	Mouse ♂	>2000	P.O.
	Rat	>2000*	s.c.
	Guinea pig	750-1000*	s.c.
nitrate	Frog	1600*	s.c.
	Mouse ♀	315(258-384)	i.p.
	Rat ♀	285(254-319)	i.p.
	Rat ♀	2900(2600-3161)	P.O.
	Rat ♀	8.9(6.8-11.8)	i.v.
	Rat ♂	59.1(40.5-86.3)	i.v.
	Guinea pig	about 500*	s.c.
Europium chloride	Mouse ♂	550(515.5-586.9)	i.p.
	Mouse ♂	5000(4505-5500)	i.p.
nitrate	Mouse ♀	320(294-349)	i.p.
	Rat ♀	210(172-256)	i.p.
	Rat ♀	>5000	P.O.
Gadolinium chloride	Mouse ♂	550(495.5-610.5)	i.p.
	Mouse ♂	>2000	P.O.
nitrate	Mouse ♀	300(261-345)	i.p.
	Rat ♀	230(204-260)	i.p.
	Rat ♀	>5000	P.O.
Terbium chloride	Mouse ♂	550(521.3-580.3)	i.p.
	Mouse ♂	5100(5049.5-5151)	P.O.
nitrate	Mouse ♀	480(444-518)	i.p.
	Rat ♀	260(232-291)	i.p.
	Rat ♀	>5000	P.O.
Dysprosium chloride	Mouse ♂	585(552-620)	i.p.
	Mouse ♂	7650(7150-8186)	P.O.
nitrate	Mouse ♀	310(261-360)	i.p.
	Rat ♀	295(236-369)	i.p.
	Rat ♀	3100(2870-3348)	P.O.
Holmium chloride	Mouse ♂	560(541-580)	i.p.
	Mouse ♂	7200(6667-7776)	P.O.
nitrate	Mouse ♀	320(302-339)	i.p.
	Rat ♀	270(237-308)	i.p.
	Rat ♀	3000(2804-3210)	P.O.
Erbium chloride	Frog	300-400*	s.c.
	Mouse ♂	535(500-562)	i.p.
nitrate	Mouse ♂	6200(5390-7140)	P.O.
	Mouse ♀	225(194-261)	i.p.
	Rat	82.8-96.6*	i.v.
	Rat ♀	230(195-271)	i.p.
	Rat ♀	35.8(27.8-49.9)	i.v.
	Rat ♂	52.4(37.0-74.5)	i.v.
Thulium chloride	Mouse ♂	485(466.3-504.4)	i.p.
	Mouse ♂	6250(5430-7190)	P.O.
nitrate	Mouse ♀	255(226-288)	i.p.
	Rat ♀	285(252-322)	i.p.
Ytterbium chloride	Mouse ♂	395(375-416.7)	i.p.
	Mouse ♂	6700(6374.9-7041.7)	P.O.
nitrate	Mouse ♀	250(185-338)	i.p.
	Rat ♀	255(220-296)	i.p.
	Rat ♀	3100(2924-3286)	P.O.
Lutetium chloride	Mouse ♂	315(267-372)	i.p.
	Mouse ♂	7100(6630-7500)	P.O.
nitrate	Mouse ♀	290(250-325)	i.p.
	Rat ♀	325(294-382)	i.p.

* Minimum lethal dose. ^b s.c., subcutaneous; P.O., oral; i.p., intraperitoneal; i.v., intravenous.

TABLE 5

Accumulation of Cerium-141 by Aquatic Life (8)

<u>Concentration Factor</u>	<u>Organism</u>
15,170	<u>Ochromonas</u> (a flagellate)
5,100	<u>Platymonas</u> (a flagellate)
7,400	<u>Chlamydomonas</u> (a flagellate)
28,500	<u>Nitzschia</u> (a diatom)
280 - 1740	Marine bacteria

"Most of the cerous salts (+3) are soluble, except for the carbonate and fluoride. It is probable, therefore, that ceric or cerous salts discharged in industrial wastes will remain in solution except at high pH values until they are oxidized and precipitated as CeO_2 ."

The most obvious, and probably the best solution to the possibility of rare earth discharges from W. R. Grace, is to require the company to maintain the high pH in its lagoon. Adding acid to lower the pH in the lagoon would increase the likelihood of discharging significant quantities of rare earths. Acid for pH reduction should be added only at or past the discharge weir.

ORGANIC ANALYSES

Gas chromatograph/mass spectrometric analyses were made of several waste and stream samples. Appendix F lists the compounds identified, concentrations (except where there was no discharge), toxicity, taste and odor, and other properties.

Negative results are not reported. However, the negative findings from the waterworks intake sample (Station A) are particularly pertinent since the August 8, 1972, sample collected by state personnel gave a positive reading for a thiophosphate pesticide (not of sufficient quantity to be identified further from that limited sample). The EPA water intake sample extract was run on a sensitive gas chromatograph through both a Coulson conductometric detector and a flame photometric detector. Concentrations of one microgram per liter or greater of any halogen-, sulphur-, or phosphorus-containing pesticide would definitely have been detected. Their absence from the extract indicates they were not present in detectable quantities in the intake water during the EPA survey in June.

BIOLOGICAL STUDY

A biological study was conducted in two parts during the weeks of June 18 and August 6. The objective of this study was to determine by in situ bioassays the effect of industrial effluents on the survival of bluegill sunfish (Lepomis macrochirus Raf.). In conjunction with this study, channel catfish (Ictalurus punctatus Raf.) were placed with the bluegill sunfish to determine if the edible flesh of catfish imparted any unusual flavor following exposure to industrial effluents.

Bluegill sunfish for use in the in situ bioassays were obtained from the Federal fish hatchery at Cohutta, Georgia; they averaged between four and six inches in length. Channel catfish for use in the flavor evaluation study were obtained from the Federal fish hatchery at Marion, Alabama; they averaged approximately 16 inches in length.

Methods and Procedures

On June 19, bluegills were placed in cages made of hardware cloth which were subsequently located at each of the following stations (Figure 2):

F-1 - Friar Branch at Airport Road bridge.

F-2 - Friar Branch at Highway 153 bridge.

C-1 - Citico Creek 50 yards upstream from Riverside Drive bridge.

C-1A - Citico Creek 150 yards downstream from Southern Railroad's main discharge ditch.

C-2 - Citico Creek 150 yards upstream from Tinker Street bridge.

SC-1 - South Chickamauga Creek at Amnicola Highway bridge.

At the time the bluegills were placed in the water, dissolved oxygen, temperature, and pH were recorded at each of the locations. When possible, the bluegills were checked every 24 hours for mortality. After 96 hours of exposure, total fish mortality was recorded.

On August 7, bluegills and catfish were placed in separate cages which were subsequently located at each of the following stations (Figure 2):

- F-3 - Friar Branch approximately 50 yards downstream from GAF discharge ditch.
- F-4 - Friar Branch 50 yards upstream from GAF discharge ditch.
- C-1A - Citico Creek 150 yards downstream from Southern Railroad's main discharge ditch.
- C-2A - Citico Creek approximately 500 yards upstream from Tinker Street bridge.
- SC-1 - South Chickamauga Creek approximately 200 yards upstream from confluence with Friar Branch.
- SC-2 - South Chickamauga Creek at Shallowford Road bridge.
- SC-3 - South Chickamauga Creek approximately 200 yards upstream from confluence with Friar Branch.
- USCG-1 - U. S. Coast Guard station on Lake Chickamauga.

As in the June 18 study, DO, temperature, and pH were recorded at the time the fish were placed in the water. The same procedure for observing bluegill mortality and determining various parameters were repeated as in the June 19 study.

The channel catfish which were placed with the bluegills were removed after 48 hours of exposure. Of the catfish remaining alive, two from each station were cleaned, frozen, and shipped on dry ice to Oregon State University for flavor evaluation (three fish from USCG-1).

The frozen samples were received at Oregon State University on August 10, 1972, and were immediately stored at -10°F until tested. For testing, each frozen sample was enclosed in aluminum foil and placed on a broiler-type pan and cooked in a large commercial-style gas oven at 400°F until the flesh flaked from the bones (approximately 150 minutes).

The cooked fish in each sample were skinned, boned, lightly mixed to insure uniform serving samples, and placed in the top of a double boiler over hot water to keep warm for serving. Two replicate tests were conducted using the same procedure. Ten experienced judges rendered decisions on both replicates. Each judge on each test received a tray containing seven sample cups. One cup, labeled "Ref.", contained the control sample for reference; the other six cups, coded with three-digit random numbers, contained the other five samples and a duplicate control sample.

The judges were asked to score on a printed ballot the intensity of off-flavor on a scale of 1 to 7, with 1 being extremely off-flavor and 7 being no off-flavor. Desirability was also scored on a scale of 1 to 7, with 1 being least desirable and 7 being most desirable.

Results

The results of the June 8 in situ bioassay study are summarized in Table 6. Data from the bluegill in situ bioassay were statistically

TABLE 6
BIOLOGICAL DATA
CHATTANOOGA, TENNESSEE - JUNE 19-22, 1972

Station	Time Test Began	In situ Bioassay Number of Fish Alive				Initial Water Quality			Calculated χ^2 .05 Level	Table χ^2 .05 Level	Mortality Significant
		0	24 ¹	48	72	96	D.O. mg/l	Temp. °C			
F-1	1340	20	-- ²	18	17	16	8.3	23	2.5	3.8	No
F-2	1315	20	-- ³	--	--	--	6.7	24	--	--	--
C-1	1605	20	17	17	17	17	1.6	24	1.4	3.8	No
C-1A	1545	20	0	0	0	0	7.2 ⁴	26	36.1	3.8	Yes
C-2	1500	20	1	1	1	1	2.0	23	32.4	3.8	Yes
SC-1	1630	20	20	20	20	20	6.4	23	Control		

- 1 Study area received 2.3 inches of rainfall on 6/20/72.
- 2 Unable to check baskets due to high water.
- 3 Basket lost due to high water.
- 4 Dissolved oxygen results questionable due to possible aeration at time of collection.

analyzed using the chi square (X^2) test to determine the significance of difference between two independent groups. Only two groups, C-1 and C-1A on Citico Creek, showed significant mortality. This was determined with the calculated chi square value was greater than the listed table value at the 5-percent level. During the August 8 study, the in situ study was deleted because all bluegills died within 24 hours at all stations, including the control.

The catfish flavor and desirability data have been summarized in Table 7. The table gives the sample mean scores and the least significant difference (LSD) at the 5-percent level, determined by analysis of variance.

Discussion and Conclusions

During the week of June 18, the study area received 2.30 inches of rainfall, the greatest amount during the evening of the 19th and the morning of the 20th. The ensuing high waters made it impossible to observe the fish every 24 hours and even to recover the cages at one station. The data reported are for extremely high water conditions. On Citico Creek, initial DO data indicate levels at which fish could not survive. The runoff and rising waters with increasing DO are the probable reasons for 14 of 20 bluegills surviving at C-1, even though the initial DO level was 1.6 mg/l. However, prior to the rain and ensuing high water, there existed deleterious conditions in Citico Creek. The contributing factor could have been low DO or some toxic chemical being discharged at the time.

It is very hazardous to most species of fish to handle and haul them during the summer months, as injury or abrasions incurred are sites for

TABLE 7

**CATFISH MEAN FLAVOR SCORES AND LEAST SIGNIFICANT DIFFERENCE (LSD)
AT THE 5-PERCENT LEVEL**

Station	Off-Flavor ¹	Desirability ²
USCG-1 (Control)	5.07	4.05
F-3	5.30	4.70
F-4	5.70	4.90
SC-1	5.47	4.75
SC-2	5.32	4.59
SC-3	5.27	4.37

¹Scale of 1 to 7 - 1 = extreme off-flavor, 7 = no off-flavor.

²Scale of 1 to 7 - 1 = least desirable, 7 = most desirable.

bacterial invasion; and with the water temperatures high, bacterial growth flourishes. This was the case in the August 8 in situ bioassay study where within 24 hours mortality occurred in all bluegills due to bacterial fin rot.

Channel catfish for the off-flavor and desirability study can also be used as in situ bioassay, in that mortality can be noted. However, the number of catfish exposed at each station was too small for statistical analysis. Catfish put in the water at C-2A began to show distress after 10 minutes. At this time, a brown color effluent was being discharged from the pipe located approximately 20 feet upstream from the catfish. After one hour of exposure, these fish were dead. A check of catfish placed at C-1A following 24 hours of exposure, revealed a complete mortality.

Catfish samples from F-3, F-4, SC-1, SC-2, and SC-3, sent to Oregon State University did not score significantly lower than the control (USCG-1) on both off-flavor and over-all desirability. Thus, to the panel of 10 experienced flavor judges, all six samples of catfish were equal on the off-flavor and desirability scales. This would indicate that industrial waste discharged into receiving waters being studied did not impart any undesirable flavor to the catfish.

In the overall analysis, neither of the two studies completely fulfilled the objectives initially set forth. The in situ bioassays provided only limited data as a result of rains and diseased fish. However, from the limited data, it was discernible that conditions in Citico Creek were not suitable for supporting a normal fish community.

Data from the Oregon State University analyses indicate that the waters receiving industrial waste do not impart any off-flavor or decrease desirability in the edible portions of the channel catfish.

STREAM DATA AND OBSERVATIONS

Friar Branch

Water quality data were collected in Friar Branch upstream (Station F-2) and downstream (Station F-1) of GAF's discharge. The most significant components of GAF's waste were ammonia and dissolved solids (averages of 104 mg/l and 3628 mg/l, respectively). The resulting stream concentrations are not accurately represented by the stream station averages because of the high runoff during the first part of the survey created by the 2.30-inch rainfall. However, flows during the last day of the survey appeared about normal, and streamflow can be calculated from GAF's discharge flow and the resulting increase in stream dissolved solids concentration for June 24 would be:

$$\frac{200 \text{ gpm} \cdot 3857 \text{ mg/l GAF Discharge}}{(709-388) \text{ mg/l Increase in Stream D.S.}} = 2420 \text{ gpm or } 5.4 \text{ cfs.}$$

Either by astute judgment in selecting "normal" or "typical" conditions, or simply by coincidence, this result of 5.4 cfs flow in Friar Branch is exactly that measured during the 1968 FWPCA survey (2) at the Airport Road bridge (Station F-1 for this survey). By contrast, the same calculation from stream and discharge averages (instead of the data for June 24 alone) gives a result of 11.5 cfs.

The June 24 concentration of ammonia in Friar Branch (the chosen "typical" condition) increased from 8.4 to 11.1 mg/l as it flowed past GAF's discharge. Ammonia toxicity to aquatic life varies considerably with pH, hardness, dissolved oxygen, time of exposure, and species exposed. Ammonia concentrations as low as 0.3 mg/l have been reported

as toxic, but 1.5 mg/l is a more commonly accepted "no effect" level (8). However, the June bioassay results showed no significant fish mortality downstream from the plant. Moreover, the August catfish taste study showed no effect on flavor or desirability of the fish flesh.

Citico Creek

Citico Creek is by far the most polluted stream in the entire study area. The fish bioassays showed this conclusively, and the chemical results (Table 8) confirm it. Dissolved oxygen (DO) means of about 3 mg/l at all Citico Creek stations (C-1, C-1A, and C-2) violate the 5 mg/l standard generally applied for the "Fish and Aquatic Life" classification assigned by the State of Tennessee to Citico Creek. In fact, seven out of eleven DO measurements showed violations of even the 3.0 mg/l lower limit that is applied to the "sag" point below a treated waste discharge.

Mean BOD₅ concentrations as high as 14.5 mg/l were recorded in Citico Creek. The highest BOD₅ mean in any other stream in the area was 6.8 mg/l in Tannery Branch.

Oil and grease scums were very apparent in Citico Creek at Station C-1 below Southern Railway's main discharge. A slight backflow from Nickajack Lake appeared to hold oil and grease in the lower reach of Citico Creek and contributed to a high of 89.0 mg/l oil and grease at Station C-1 on Thursday, June 22, 1972. Citico Creek samples were the only stream samples taken throughout the survey that yielded oil and grease results above the minimum detectable limit (5 mg/l) of the analytical method listed in Appendix A. A comparison of point sources of oil and grease in the study area (Figure 42) also shows that Southern's main outfall is a very significant source, if not the most significant source of oil and grease -- see discussion of Southern Railway System's waste.

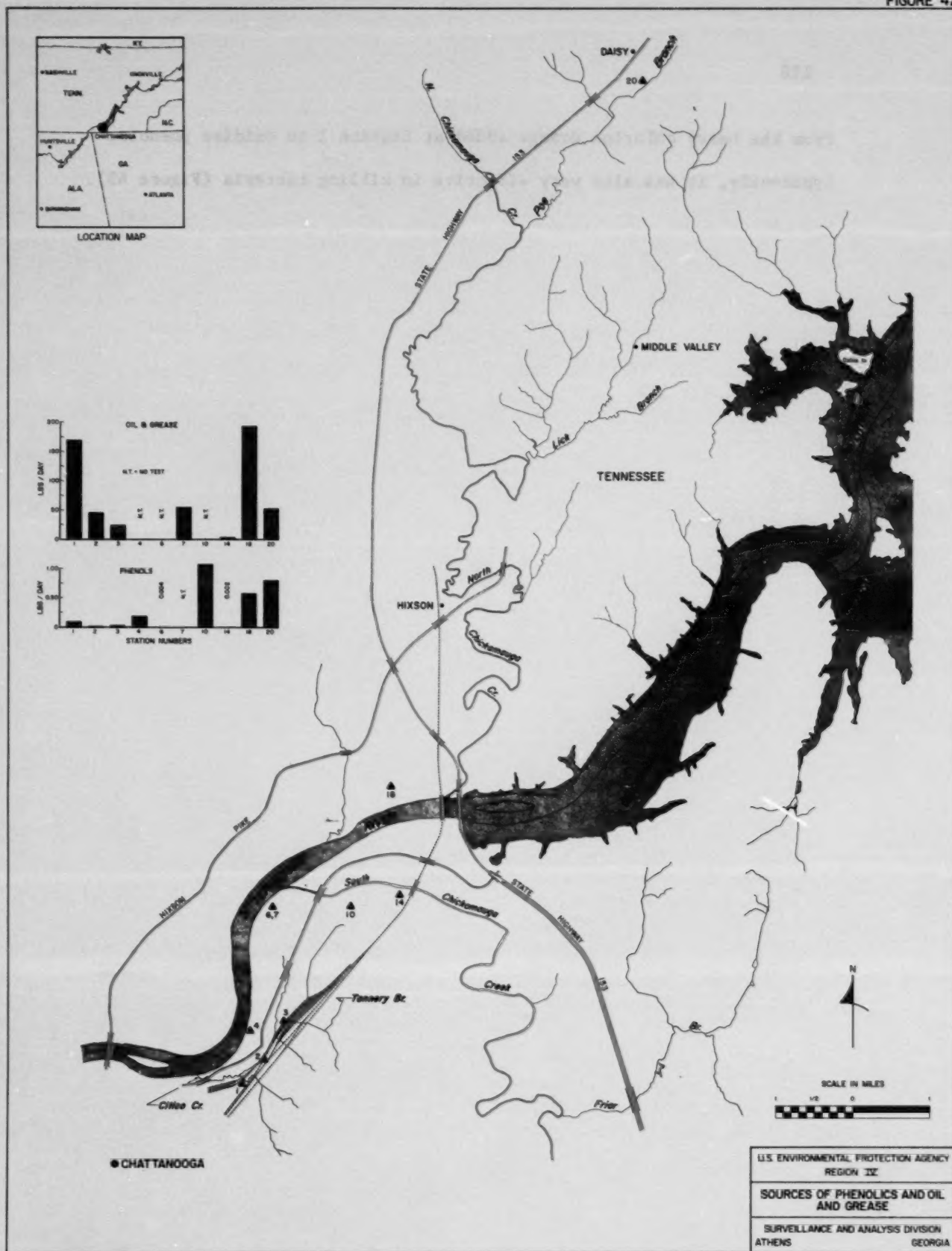
Total and fecal coliform geometric means were high at Stations C-1 and C-2, but the less than 200 per 100 ml density at C-1A probably results

TABLE 8

Comparison of Citico Creek Water Quality (C-1, C-1A, C-2)
With That Measured in South Chickamauga Creek (SC-1)
and Tannery Branch (TAN)

	Mean Values in Milligrams per Liter										D.O.
	BOD ₅	Total Solids	Dissolved Solids	Non-Filt. Solids	Oil & Grease	NH ₃ -N	KJEL -N	NO ₂ & NO ₃	Total P	TOC	
C-1	14.5	377	331	46	54.0	1.26	1.66	1.35	0.54	16.5	3.1
C-1A	>19.8	438	431	7	<17	0.50	5.25	0.96	0.52	46.0	3.2
C-2	2.9	430	389	41	<5	0.47	1.01	2.09	0.47	15.0	2.8
SC-1	0.8	169	144	25	--	0.32	0.68	1.06	0.22	6.0	6.2
TNK	6.8	247	223	20	<5	0.08	0.46	0.39	0.06	6.0	---

	Mean Values in Micrograms per Liter										Geometrical Mean MPN per 100 ml Coliforms
	Total Cr	Cu	Fe	Pb	Mn	Zn	Phenols	pH	Total	Fecal	
C-1	<50	<50	3300	<100	730	970	9	7.0	106,000	18,000	
C-1A	<50	<50	788	<100	522	198	<33	6.8	<200	<200	
C-2	<50	<50	713	<100	385	23	6	7.0	55,000	7,300	
SC-1	<50	<50	1638	<100	72	28	--	7.3	8,775	680	
TAN	<50	<50	788	<100	227	<10	<5	7.3	12,000	1,600	

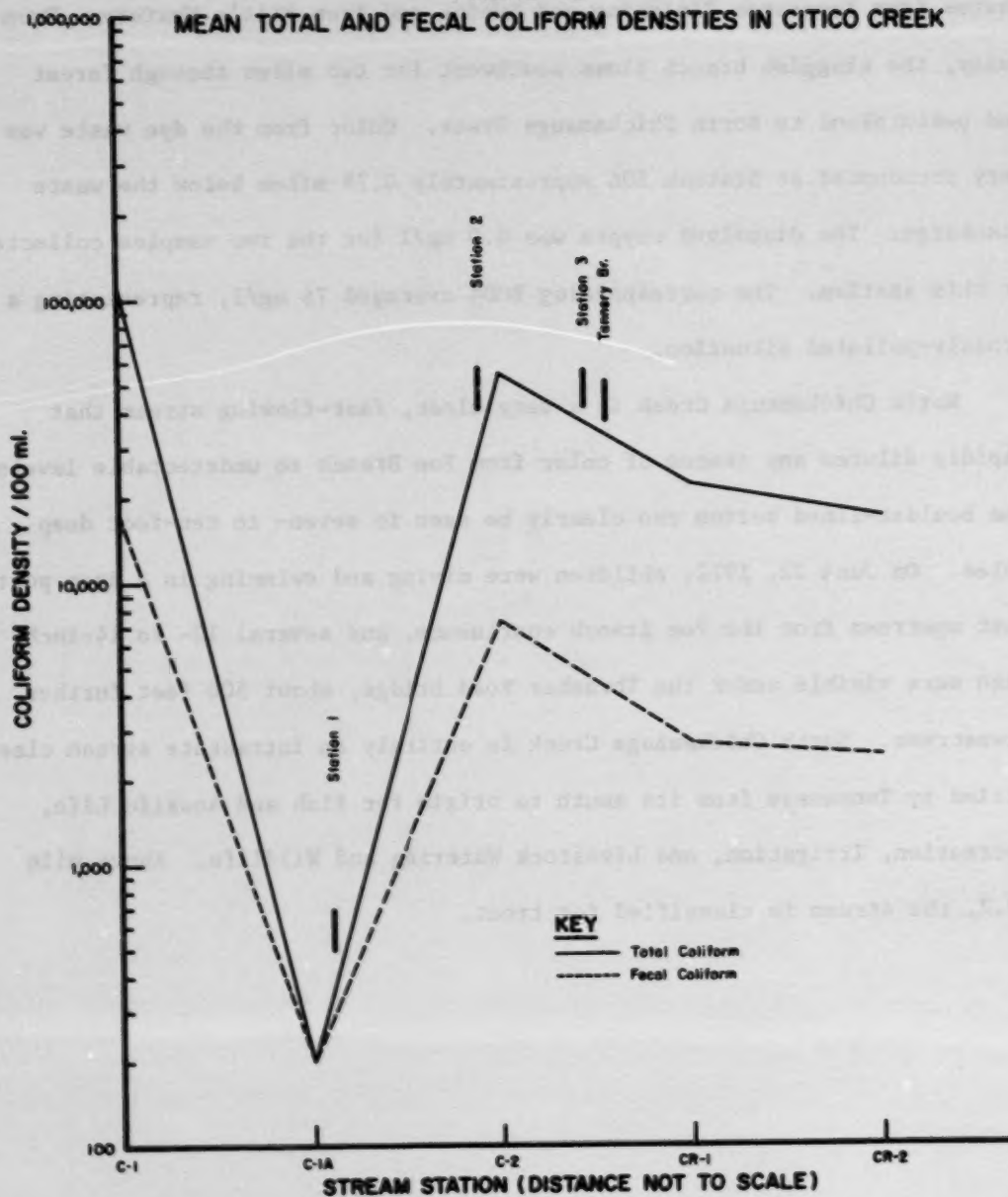


from the heavy chlorine dosage added at Station 1 to oxidize phenols. Apparently, it was also very effective in killing bacteria (Figure 43).



FIGURE 43

MEAN TOTAL AND FECAL COLIFORM DENSITIES IN CITICO CREEK



Poe Branch and North Chickamauga Creek

Poe Branch rises near Daisy, Tennessee, where it receives untreated wastes from Tennessee Finishing and Dyeing and from Hill's Hosiery. From Daisy, the sluggish branch flows southwest for two miles through forest and pastureland to North Chickamauga Creek. Color from the dye waste was very pronounced at Station 20A approximately 0.75 miles below the waste discharge. The dissolved oxygen was 0.0 mg/l for the two samples collected at this station. The corresponding BOD₅ averaged 76 mg/l, representing a grossly-polluted situation.

North Chickamauga Creek is a very clear, fast-flowing stream that rapidly dilutes any traces of color from Poe Branch to undetectable levels. The boulder-lined bottom can clearly be seen in seven- to ten-foot deep holes. On June 22, 1972, children were diving and swimming in a deep portion just upstream from the Poe Branch confluence, and several 12- to 14-inch fish were visible under the Thrasher Road bridge, about 500 feet further downstream. North Chickamauga Creek is entirely an intrastate stream classified by Tennessee from its mouth to origin for Fish and Aquatic Life, Recreation, Irrigation, and Livestock Watering and Wildlife. Above mile 13.2, the stream is classified for trout.

South Chickamauga Creek

In the Chattanooga area, South Chickamauga Creek is a slow-moving stream subject to frequent flow reversals in the downstream reach where it enters Nickajack Lake. Several pollution sources discharge directly to South Chickamauga Creek and its tributaries, but the large dilution available has allowed it to remain a relatively good warmwater fishery. Station SC-1 at the Amnicola Highway bridge was chosen as the control station for fish bioassay tests.

Table 5 shows a chemical comparison of the water quality in South Chickamauga Creek with that in Citico Creek and Tannery Branch. The main differences appear to be dissolved oxygen, and the typical sewage pollution parameters of BOD₅, TOC, and coliforms, which are generally lower in South Chickamauga Creek.

Tennessee River

The Tennessee River is impounded throughout the study area by Chickamauga and Nickajack Dams. The almost continuous and successful fishing on both sides of Chickamauga Dam attest to the excellent warmwater fishing upstream from the input of pollution from the Chattanooga area. Because of these impoundments, water quality and streamflow varied only slightly during and immediately following the heavy rainfall on June 20 and 21. Daily average discharges through Chickamauga Dam during the survey were:

<u>Date</u>	<u>cfs</u>
June 19	32,380
June 20	46,350
June 21	34,500
June 22	36,980
June 23	40,180
June 24	28,780
Survey Average	36,530

Hourly flows varied from zero (from 1:00 AM to 4:00 AM on June 19) to 47,800 cfs (from 8:00 PM to 9:00 PM on June 19). Table 9 compares EPA average concentrations from Station A (a raw water source within the water purification plant) with averages of 27 samples collected across a transect of the river (south bank, mid channel, and north bank) at the water intakes (TRM 465.4) by the City Water Company at Chattanooga (5). The slightly-higher EPA metal values may be attributable to intake pipes and plumbing within the plant, but no firm conclusion can be drawn.

Mean total and fecal coliform densities measured at Station A were 7100 and 1600/100 ml, respectively. One pathogenic bacteria serotype, Salmonella cubana, was isolated at Station A.

TABLE 9
COMPARISON OF EPA ANALYZED RAW WATER
QUALITY (JUNE 20-24, 1972) WITH CITY WATER COMPANY
ANALYZED RIVER WATER QUALITY AT THE INTAKES
(MAY 23-JUNE 7, 1972)

	<u>All Concentrations in Micrograms per Liter</u>						
	<u>Mn</u>	<u>Fe</u>	<u>Cu</u>	<u>Pb</u>	<u>Zn</u>	<u>Cr</u>	<u>NH₃-N</u>
EPA Averages	90	1350	94	<100	70	<50	203
City Water Co. Averages	40	180	<10	<40	10	<10	470
EPA Highs	100	1900	105	<100	215	<50	280
City Water Co. Highs	60	27	10	<40	30	20	950
EPA Lows	80	925	80	<100	15	<50	70
City Water Co. Lows	30	10	<10	<40	<10	<10	350

REFERENCES

- (1) Tennessee Stream Pollution Control Board, Ammonia Nitrogen - Chlorine Demand Field Survey of Friar Branch, S. Chickamauga Creek, Tennessee River in the Chattanooga Vicinity, (May 1968).
- (2) Federal Water Pollution Control Administration, Pollution Affecting South Chickamauga Creek and Nickajack Lake, Chattanooga, Tennessee, Athens, Georgia (February 1969).
- (3) J. Salvato, W. Wilkie, and B. Mead, "Sanitary Landfill Prevention and Control", Journal WPCF, Vol. 43, No. 10, pp. 2084-2099, (October 1971).
- (4) Tennessee Water Quality Control Board, Public Hearing on Water Uses, Stream Standards, and Implementation Plans for all Streams Within the Tennessee River Basin from the Tennessee-Alabama State Line to the Mouth of the Hiwassee River, Nashville, (December 2, 1971).
- (5) City Water Company of Chattanooga, "Preliminary Report to Task Force Committee Pertaining to Surveillance of Raw Water Quality - Tennessee River" (May 19, 1972).
- (6) City Water Company of Chattanooga, "Supplement to Preliminary Report to the Task Force Committee Pertaining to Surveillance of Raw Water, May 23 through June 7, 1972" (June 23, 1972).
- (7) John A. Campbell, Tennessee Division of Water Quality Control, "Tour and Survey of Industrial and Sanitary Discharges above Chattanooga City Water Intake", Memo prepared for Task Force Committee Members (April 7, 1972).
- (8) J. E. McKee and H. W. Wolf, Water Quality Criteria, Second Edition (Revised 1963), California State Water Resources Control Board, Publication No. 3-A, Sacramento (1971).
- (9) Federal Water Pollution Control Administration, Water Quality Criteria, Washington, D. C. (April 1, 1968).
- (10) Thomas J. Haley, "Pharmacology and Toxicology of the Rare Earth Elements," Journal of Pharmaceutical Sciences, 54 (5), pp. 663-669, May 1965.

ANALYTICAL METHODS

Reference	Method	Substance
1	Microchemical Oxygen Balance	Microchemical Oxygen Balance
2	Gravimetric	Gravimetric
3	Gravimetric	Gravimetric
4	Gravimetric	Gravimetric
5	Gravimetric	Gravimetric
6	Gravimetric	Gravimetric
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98	Gravimetric	Gravimetric
99	Gravimetric	Gravimetric
100	Gravimetric	Gravimetric

APPENDIX A

ANALYTICAL METHODS

1. Standard Methods for Examination of Water and Wastewater, 15th Edition, 1971.

2. EPA Manual of Methods for Chemical Analysis of Water and Wastewater, 1971.

3. ASTM Book of Standards, Part 13, 1971.

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ANALYTICAL METHODS

Parameter	Method	Reference
Biochemical Oxygen Demand	Winkler DO, 5-Day	1, 2
Total Organic Carbon	Carbon Analyzer	2
Nonfilterable Solids	Gravimetric	1
Color	Visual Against Co.-Pt. Standard	1
Total Kjeldahl Nitrogen	Automated Phenolate Method	2
Ammonia	Automated Phenolate Method	2
Nitrate-Nitrite	Copper-Cadmium Reduction, Automated	2
Phosphorus	Ascorbic Acid Method	2
Detergent	Methylene Blue	1
Acidity and Alkalinity	Volumetric	1
Dissolved Oxygen	Winkler	1
Oil and Grease	Solvent Extraction	1
Phenols	4-Aminoantipyrine	1
Total Solids	Gravimetric, 105°C	1
Filterable Solids	Difference between Total and Suspended Solids	-
Metals	Atomic Absorption	2
pH	Electrometric	1
Total Coliform	MPN	1
<u>Salmonella</u>	Method of Spino	-
Fecal Coliform	MPN	1
Organic Scan	SEWL	-

1. Standard Methods for Examination of Water and Wastewater, 13th Edition, 1971.
2. EPA Manual of Methods for Chemical Analyses of Water and Wastes, 1971.
3. ASTM Book of Standards, Part 23, 1971.

STATION LOCATIONS

Water samples were taken from the following stations:

1. The Elbow River (Station 1) - Located just above the dam.

2. The Elbow River (Station 2) - Located just below the dam.

3. The Elbow River (Station 3) - Located just below the dam.

4. The Elbow River (Station 4) - Located just below the dam.

5. The Elbow River (Station 5) - Located just below the dam.

6. The Elbow River (Station 6) - Located just below the dam.

7. The Elbow River (Station 7) - Located just below the dam.

8. The Elbow River (Station 8) - Located just below the dam.

9. The Elbow River (Station 9) - Located just below the dam.

10. The Elbow River (Station 10) - Located just below the dam.

APPENDIX B

STATION LOCATIONS

1. The Elbow River (Station 1) - Located just above the dam.

2. The Elbow River (Station 2) - Located just below the dam.

3. The Elbow River (Station 3) - Located just below the dam.

4. The Elbow River (Station 4) - Located just below the dam.

5. The Elbow River (Station 5) - Located just below the dam.

6. The Elbow River (Station 6) - Located just below the dam.

7. The Elbow River (Station 7) - Located just below the dam.

8. The Elbow River (Station 8) - Located just below the dam.

9. The Elbow River (Station 9) - Located just below the dam.

10. The Elbow River (Station 10) - Located just below the dam.

11. The Elbow River (Station 11) - Located just below the dam.

12. The Elbow River (Station 12) - Located just below the dam.

STATION LOCATIONS

Water Supply and Waste Source Stations

- A The City Water Company of Chattanooga. Sampled from raw water tap in the company laboratory. The water intake is at RM 465.4 in Nickajack Reservoir.
- 1 Southern Railway System at the DeButts Yard treatment facility. Samples were collected at the discharge weir before the waste entered an unnamed branch 0.1 mile above its confluence with Citico Creek. The branch enters Citico Creek at mile 0.8.
- 2 Southern Railway System at storm drain from Citico Yards discharging to Citico Creek at mile 1.3 and approximately 100 yards upstream from Tinker Street bridge. Samples were collected from the storm drain discharge.
- 3 Southern Railway System at storm drain from Citico Yards discharging to Citico Creek at mile 1.9. Samples were collected from the storm drain discharge.
- 4 City of Chattanooga Amnicola Dump leachate stream. Samples were collected from the leachate stream approximately 20 feet above the point where it flows into Nickajack Reservoir at RM 465.9.
- 5 Seaboard Allied Milling washwater discharge to Nickajack Reservoir at RM 467.7. Samples were collected from the waste stream roughly 100 feet before it entered the reservoir.
- 6 Central Soya process waste discharge to Nickajack Reservoir at RM 467.9. Samples were taken at the effluent weir from the waste treatment facility.

- 7 Central Soya storm drain to Nickajack Reservoir at RM 467.9. Samples were taken at the discharge weir.
- 8 Alco Chemical Company. Process wastes are presently being retained on site in a holding pond pending development of a suitable treatment system. Samples were collected from a recirculating pump in the storage pond.
- 9 Alco Chemical Company cooling water discharge was sampled at the discharge weir just before it flows into South Chickamauga Creek at mile 0.8.
- 9a Alco Chemical Company. Old sedimentation pond to the right of loading area facing the back of the building.
- 10 Mueller Company. Samples were collected at a temporary weir installed approximately 50 feet below the two settling basins. The waste enters South Chickamauga Creek at mile 1.2.
- 11 Mueller Company. Samples were collected at the effluent weir from the domestic waste activated sludge plant. This waste enters South Chickamauga Creek at mile 1.2.
- 12 W. R. Grace Chemical Company. Process waste samples were collected at the effluent weir from the settling pond. This waste flows via a small stream for approximately 1/2 mile, entering South Chickamauga Creek at mile 1.3.
- 13 W. R. Grace Chemical Company. Samples were collected from the leachate stream approximately 1/5 mile below the solid waste disposal area. The stream enters South Chickamauga Creek at mile 1.3.

- 14 City of Chattanooga North Hawthorne Street Dump. Samples were collected from the main leachate stream which flows into South Chickamauga Creek at mile 1.5.
- 15 GAF Corporation. Samples were collected at the discharge weir immediately before the waste flows into Friar Branch at mile 0.6. Friar Branch flows into South Chickamauga Creek at mile 8.7.
- 16 Farmers Chemical Company. Samples were collected at the discharge weir roughly 200 feet above the Bonny Oaks Road bridge. The waste flows for 1.5 miles in an unnamed branch where it joins Frairs Branch at mile 2.8.
- 17 Volunteer Army Ammunition Plant, Chattanooga, Tennessee. Samples were collected from the waste stream approximately 100 feet below the sedimentation pond dam and 1300 feet below Highway 58 Bridge. This point is approximately 1000 feet above the headwaters of Harrison Bay.
- 18 E. I. DuPont deNemours and Company, Chattanooga Tennessee. Samples were collected below the settling pond at the Parshall Flume. The waste enters Nickajack Reservoir at RM 469.9.
- 18A E. I. DuPont deNemours and Company, Chattanooga, Tennessee. Raw water supply samples were collected from the raw water tap in the filter plant laboratory.
- 19 Hill's Hosiery Mill, Daisy, Tennessee. No samples were taken at this location.
- 20 Tennessee Finishing and Dyeing, Daisy, Tennessee. Samples were collected approximately 200 feet below the plant discharge in the side

ditch of a city street. The waste flows roughly 1000 feet to intersect Poe Branch at mile 3.1. Poe Branch flows into North Chickamauga Creek at mile 17.

Stream Stations

- 20A Poe Branch at a paved highway bridge $3/4$ mile below the point where Tennessee Finishing and Dyeing waste enters.
- C-1 Citico Creek approximately 100 yards upstream from Riverside Drive bridge at mile 0.2.
- C-1A Citico Creek, 100 feet downstream from the unnamed tributary carrying Southern Railway's treatment plant effluent at mile 0.78.
- C-2 Citico Creek, approximately 200 yards upstream from Tinker Street bridge at mile 1.35.
- CR-1 Unnamed tributary to Citico Creek at mile 2.4. Samples were collected on the upstream side of Riverside Drive bridge.
- CR-2 Unnamed tributary to Citico Creek at mile 2.4. Samples were collected at the upstream end of the culvert under Latta Street. The station is immediately downstream from Tech Finishing waste discharge and approximately 50 yards upstream from Station CR-1.
- CR-3 Unnamed tributary to Citico Creek at mile 2.4. This station is approximately 75 yards upstream from Tech Finishing's waste discharge.
- TAN Tannery Branch at mile 0.35 immediately upstream from culvert under Southern Railway Yards. Tannery Branch is tributary to Citico Creek at mile 1.9.
- SC-1 South Chickamauga Creek on the upstream side of Amnicola Highway bridge at mile 0.5.
- F-1 Friar Branch at mile 0.3 on upstream side of New Airport Road bridge. Friar Branch is tributary to South Chickamauga Creek at mile 8.7.
- F-2 Friar Branch at mile 1.1 on upstream side of Highway 153 bridge.

GENERAL WATER QUALITY CRITERIA FOR THE DEFINITION AND CONTROL
OF POLLUTION IN THE WATERS OF TENNESSEE

Adopted on May 26, 1967

Amended on November 17, 1967, May 22, 1970, October 26, 1971,
and December 14, 1971

Tennessee Water Quality Control Board

The Water Quality Control Act of 1971, Chapter 164 Public Acts of 1971 as Amended by Chapter 385, makes it the duty of the Water Quality Control Board to study and investigate all problems concerned with the pollution of the waters of the State and with its prevention, abatement, and control and to establish such standards of quality for any waters of the State in relation to their reasonable and necessary use as the Board shall deem to be in the public interest and establish general policies relating to existing or proposed future pollution as the Board shall deem necessary to accomplish the purpose of the Control Act. The following general considerations and criteria are officially adopted by the Board as a guide in determining the permissible conditions of waters with respect to pollution and the preventive or corrective measures required to control pollution in various waters or in different sections of the same waters.

GENERAL CONSIDERATIONS

1. Waters have many uses which in the public interest are reasonable and necessary. Such uses include: sources of water supply for domestic and industrial purposes; propagation and maintenance of fish and other desirable aquatic life; recreational boating and fishing; the final disposal of municipal sewage and industrial waste following adequate treatment; stock watering and irrigation; navigation; generation of power; and the enjoyment of scenic and esthetic qualities of the waters.
2. The rigid application of uniform water quality is not desirable or reasonable because of the varying uses of such waters. The assimilative capacity of a stream for sewage and waste varies depending upon various factors including the following: volume of flow, depth of channel, the presence of falls or rapids, rate of flow, temperature, natural characteristics, and the nature of the stream. Also the relative importance assigned to each use will differ for different waters and sections of waters throughout the stream.
3. To permit reasonable and necessary uses of the waters of the State, existing pollution should be corrected as rapidly as practical and future pollution controlled by treatment plants

or other measures. There is an economical balance between the cost of sewage and waste treatment and the benefits received. Within permissible limits, the dilution factor and the assimilative capacity of surface water should be utilized. Waste recovery, control of rates and dispersion of waste into the streams, and control of rates and characteristics of flow of waters in the stream where adequate, will be considered to be a means of correction.

4. Sewage, industrial wastes, or other wastes, as defined in The Water Quality Control Act of 1971, Chapter 164 Public Acts of 1971, as amended by Chapter 386, shall not be discharged into or adjacent to streams or other surface waters in such quantity and of such character or under such conditions of discharge in relation to the receiving waters as will result in visual or olfactory nuisances, undue interference to other reasonable and necessary uses of the water, or appreciable damage to the natural processes of self-purification. In relation to the various qualities and the specific uses of the receiving waters, no sewage, industrial wastes, or other wastes discharged shall be responsible for conditions that fail to meet the criteria of water quality outlined below. Bypassing or accidental spills will not be tolerated.

The criteria of water quality outlined below are considered as guides in applying the water quality objectives in order to insure reasonable and necessary uses of the waters of the State. In order to protect the public health and maintain the water suitable for other reasonable and necessary uses; to provide for future development; to allow proper sharing of available water resources; and to meet the needs of particular situations, additional criteria will be set.

CRITERIA OF WATER CONDITIONS

1. Domestic Raw Water Supply

- (a) Dissolved Oxygen - There shall always be sufficient dissolved oxygen present to prevent odors of decomposition and other offensive conditions.
- (b) pH - The pH value shall lie within the range of 6.0 to 9.0 and shall not fluctuate more than 1.0 unit in this range over a period of 24 hours.
- (c) Hardness or Mineral Compounds - There shall be no substances added to the waters that will increase the hardness or mineral content of the waters to such an extent to appreciably impair the usefulness of the water as a source of domestic water supply.

- (d) Total Dissolved Solids - The total dissolved solids shall at no time exceed 500 mg/l.
- (e) Solids, Floating Materials and Deposits - There shall be no distinctly visible solids, scum, foam, oily slick or the formation of slimes, bottom deposits or sludge banks of such size or character as may impair the usefulness of the water as a source of domestic water supply.
- (f) Turbidity or Color - There shall be no turbidity or color added in amounts or characteristics that can not be reduced to acceptable concentrations by conventional water treatment processes.
- (g) Temperature - The maximum water temperature change shall not exceed 3°C relative to an upstream control point. The temperature of the water shall not exceed 30.5°C and the maximum rate of change shall not exceed 2°C per hour. The temperature of impoundments where stratification occurs will be measured at a depth of 5 feet, or mid-depth whichever is less, and the temperature in flowing streams shall be measured at mid-depth.
- (h) Microbiological Coliform - Coliform group shall not exceed 10,000 per 100 ml. as a monthly average value (either MPN or MF count); nor exceed this number in more than 20 per cent of the samples examined during any month; nor exceed 20,000 per 100 ml. in more than five per cent of such samples. These values may be exceeded provided the organisms are known to be of nonfecal origin. No disease producing bacteria or other objectionable organisms shall be added to surface waters which will result in the contamination of said waters to such an extent as to render the water unsuitable as sources of domestic water supply after conventional water treatment.
- (i) Taste or Odor - There shall be no substances added which will result in taste or odor that prevent the production of potable water by conventional water treatment processes.
- (j) Toxic Substances - There shall be no toxic substances added to the waters that will produce toxic conditions that materially affect man or animals or impair the safety of a conventionally treated water supply.
- (k) Other Pollutants - Other pollutants shall not be added to the water in quantities that may be detrimental to public health or impair the usefulness of the water as a source of domestic water supply.

2. Industrial Water Supply.

- (a) Dissolved Oxygen - There shall always be sufficient dissolved oxygen present to prevent odors of decomposition and other offensive conditions.
- (b) pH - The pH value shall lie within the range of 6.0 to 9.0 and shall not fluctuate more than 1.0 unit in this range over a period of 24 hours.
- (c) Hardness or Mineral Compounds - There shall be no substances added to the waters that will increase the hardness or mineral content of the waters to such an extent as to appreciably impair the usefulness of the water as a source of industrial water supply.
- (d) Total Dissolved Solids - The total dissolved solids shall at no time exceed 500 mg/l.
- (e) Solids, Floating Materials and Deposits - There shall be no distinctly visible solids, scum, foam, oily slick or the formation of slimes, bottom deposits or sludge banks of such size or character as may impair the usefulness of the water as a source of industrial water supply.
- (f) Turbidity or Color - There shall be no turbidity or color added in amounts or characteristics that can not be reduced to acceptable concentrations by conventional water treatment processes.
- (g) Temperature - The maximum water temperature change shall not exceed 3° relative to an upstream control point. The temperature of the water shall not exceed 30.5°C and the maximum rate of change shall not exceed 2° per hour. The temperature of impoundments where stratification occurs will be measured at a depth of 5 feet, or mid-depth whichever is less, and the temperature in flowing streams shall be measured at mid-depth.
- (h) Taste or Odor - There shall be no substances added that will result in taste or odor that would prevent the use of the water for industrial processing.
- (i) Toxic Substances - There shall be no substances added to the waters that may produce toxic conditions that will adversely affect the water for industrial processing.
- (j) Other Pollutants - Other pollutants shall not be added to the waters in quantities that may adversely affect the water for industrial processing.

3. Fish and Aquatic Life.

- (a) Dissolved Oxygen - The dissolved oxygen shall be maintained at 5.0 mg/l except in limited sections of the stream receiving treated effluents. In these limited sections, a minimum of 3.0 mg/l dissolved oxygen shall be allowed. The dissolved oxygen content shall be measured at mid-depth in waters having a total depth of ten (10) feet or less and at a depth of five (5) feet in waters having a total depth of greater than ten (10) feet. A minimum dissolved oxygen content of 6.0 mg/l shall be maintained in recognized trout streams.
- (b) pH - The pH value shall lie within the range of 6.5 to 8.5 and shall not fluctuate more than 1.0 unit in this range over a period of 24 hours.
- (c) Solids, Floating Materials and Deposits - There shall be no distinctly visible solids, scum, foam, oily slick or the formation of slimes, bottom deposits or sludge banks of such size or character that may be detrimental to fish and aquatic life.
- (d) Turbidity or Color - There shall be no turbidity or color added in such amounts or of such character that will materially affect fish and aquatic life.
- (e) Temperature - The maximum water temperature change shall not exceed 3C° relative to an upstream control point. The temperature of the water shall not exceed 30.5°C and the maximum rate of change shall not exceed 2C° per hour. The temperature of recognized trout waters shall not exceed 20°C. There shall be no abnormal temperature changes that may affect aquatic life unless caused by natural conditions. The temperature of impoundments where stratification occurs will be measured at a depth of 5 feet, or mid-depth whichever is less, and the temperature in flowing streams shall be measured at mid-depth.
- (f) Taste or Odor - There shall be no substances added that will impart unpalatable flavor to fish or result in noticeable offensive odors in the vicinity of the water or otherwise interfere with fish or aquatic life.
- (g) Toxic Substances - There shall be no substances added to the waters that will produce toxic conditions that affect fish or aquatic life.
- (h) Other Pollutants - Other pollutants shall not be added to the waters that will be detrimental to fish or aquatic life.

4. Recreation.

- (a) Dissolved Oxygen - There shall always be sufficient dissolved oxygen present to prevent odors of decomposition and other offensive conditions.
- (b) pH - The pH value shall lie within the range of 6.0 to 9.0 and shall not fluctuate more than 1.0 unit in this range over a period of 24 hours.
- (c) Solids, Floating Materials and Deposits - There shall be no distinctly visible solids, scum, foam, oily slick, or the formation of slimes, bottom deposits or sludge banks of such size or character that may be detrimental to recreation.
- (d) Turbidity or Color - There shall be no turbidity or color added in such amounts or character that will result in an objectionable appearance to the water.
- (e) Temperature - The maximum water temperature change shall not exceed 3°C relative to an upstream control point. The temperature of the water shall not exceed 30.5°C and the maximum rate of change shall not exceed 2°C per hour. The temperature of impoundments where stratification occurs will be measured at a depth of 5 feet, or mid-depth whichever is less, and the temperature in flowing streams shall be measured at mid-depth.
- (f) Microbiological Coliform - The fecal coliform group shall not exceed 5,000 per 100 ml. as a monthly average value nor exceed this number in more than 20 percent of the samples examined during any month nor exceed 20,000 per 100 ml. in more than five per cent of such samples. In those waters that are physically suitable and available to the public for water-contact recreation the fecal coliform concentration shall not exceed 1,000 per 100 ml. in any two consecutive samples collected during the months of May through September. Water areas near outfalls of domestic sewage treatment plants are not considered suitable for water-contact recreation.
- (g) Taste or Odor - There shall be no substances added that will result in objectionable taste or odor.
- (h) Toxic Substances - There shall be no substances added to the water that will produce toxic conditions that affect man or animal.
- (i) Other Pollutants - Other pollutants shall not be added to the water in quantities which may have a detrimental effect on recreation.

5. Irrigation

- (a) Dissolved Oxygen - There shall always be sufficient dissolved oxygen present to prevent odors of decomposition and other offensive conditions.
- (b) pH - The pH value shall lie within the range of 6.0 to 9.0 and shall not fluctuate more than 1.0 unit in this range over a period of 24 hours.
- (c) Hardness or Mineral Compounds - There shall be no substances added to the water that will increase the mineral content to such an extent as to impair its use for irrigation.
- (d) Solids, Floating Materials and Deposits - There shall be no distinctly visible solids, scum, foam, oily slick, or the formation of slimes, bottom deposits, or sludge banks of such size or character as may impair the usefulness of the water for irrigation purposes.
- (e) Temperature - The temperature of the water shall not be raised or lowered to such an extent as to interfere with its use for irrigation purposes.
- (f) Toxic Substances - There shall be no substances added to water that will produce toxic conditions that will affect the water for irrigation.
- (g) Other Pollutants - Other pollutants shall not be added to the water in quantities which may be detrimental to the waters used for irrigation.

6. Livestock Watering and Wildlife

- (a) Dissolved Oxygen - There shall always be sufficient dissolved oxygen present to prevent odors of decomposition and other offensive conditions.
- (b) pH- The pH value shall lie within the range of 6.0 to 9.0 and shall not fluctuate more than 1.0 unit in this range over a period of 24 hours.
- (c) Hardness or Mineral Compounds - There shall be no substances added to water that will increase the mineral content to such an extent as to impair its use for livestock watering and wildlife.
- (d) Solids, Floating Materials and Deposits - There shall be no distinctly visible solids, scum, foam, oily slick, or the

formation of slimes, bottom deposits or sludge banks of such size or character as to interfere with livestock watering and wildlife.

- (e) Temperature - The temperature of the water shall not be raised or lowered to such an extent as to interfere with its use for livestock watering and wildlife.
- (f) Toxic Substances - There shall be no substances added to water that will produce toxic conditions that will affect the water for livestock watering and wildlife.
- (g) Other Pollutants - Other pollutants shall not be added to the water in quantities which may be detrimental to the water for livestock watering and wildlife.

7. Navigation

- (a) Dissolved Oxygen - There shall always be sufficient dissolved oxygen present to prevent odors of decomposition and other offensive conditions.
- (b) Hardness or Mineral Compounds - There shall be no substances added to the water that will increase the mineral content to such an extent as to impair its use for navigation.
- (c) Solids, Floating Materials and Deposits - There shall be no distinctly visible solids, scum, foam, oily slick, or the formation of slimes, bottom deposits or sludge banks of such size or character as to interfere with navigation.
- (d) Temperature - The temperature of the water shall not be raised or lowered to such an extent as to interfere with its use for navigation purposes.
- (e) Toxic Substances - There shall be no substances added to water that will produce toxic conditions that will affect the water for navigation.
- (f) Other Pollutants - Other pollutants shall not be added to the water in quantities which may be detrimental to the waters used for navigation.

These criteria should not be construed as permitting the degradation of higher quality water when such can be prevented by reasonable pollution control measures. The above conditions are recognized as applying to waters affected by the discharge of sewage and/or industrial waste or other waste and not resulting from natural causes.

DEFINITIONS

1. Conventional Water Treatment - Conventional water treatment as referred to in the criteria denotes coagulation, sedimentation, filtration and chlorination.
2. Mixing Zone - Mixing zone refers to that section of flowing stream or impounded waters necessary for effluents to become dispersed.

The mixing zone necessary in each particular case shall be defined by the Tennessee Water Quality Control Board.

INTERPRETATION OF CRITERIA

1. Interpretations of the above criteria shall conform to any rules and regulations or policies adopted by the Water Quality Control Board.
2. Insofar as practicable, the effect of treated sewage or waste discharges on the receiving waters shall be considered after they are mixed with the waters and beyond a reasonable zone of immediate effect upon the qualities of the waters. The extent to which this is practicable depends upon local conditions and the proximity and nature of other uses of the waters.
3. The technical and economical feasibility of waste treatment, recovery, or adjustment of the method of discharge to provide correction shall be considered in determining the time to be allowed for the development of practicable methods and for the specified correction.
4. The criteria set forth shall be applied on the basis of the following stream flows: unregulated streams - stream flows equal to or exceeding the 3-day minimum, 20-year recurrence interval; regulated streams - instantaneous minimum flow.
5. In general, deviations from normal water conditions may be undesirable, but the rate and extent of the deviations should be considered in interpreting the above criteria.
6. The criteria and standards provide that all discharges of sewage, industrial waste, and other wastes will receive the best practicable treatment (secondary or the equivalent) or control according to the policy and procedure of the Tennessee Water Quality Control Board. A degree of treatment greater than secondary when necessary to protect the water uses will be required for selected sewage and waste discharges.

TENNESSEE ANTIDEGRADATION STATEMENT

1. The Standards and Plan adopted are designed to provide for the protection of existing water quality and/or the upgrading or "enhancement" of water quality in all waters within Tennessee. It is recognized that some waters may have existing quality better than established standards.
2. The Criteria and Standards shall not be construed as permitting the degradation of these higher quality waters when such can be prevented by reasonable pollution control measures. In this regard, existing high quality water will be maintained unless and until it is affirmatively demonstrated to the Tennessee Water Quality Control Board that a change is justifiable as a result of necessary social and economic development.
3. All discharges of sewage, industrial waste, or other waste shall receive the best practicable treatment (secondary or the equivalent) or control according to the policy and procedure of the Tennessee Water Quality Control Board. A degree of treatment greater than secondary when necessary to protect the water uses will be required for selected sewage and waste discharges.
4. In implementing the provisions of the above as they relate to interstate streams, the Tennessee Water Quality Control Board will cooperate with the appropriate Federal Agency in order to assist in carrying out responsibilities under the Federal Water Pollution Control Act, as amended.

APPLICABLE WATER QUALITY STANDARDS

Surface and Subsurface Water (Temperature Class)

The location of the study area, including the reach of the river between the mouth of Chickasaw Creek at Johnson River Mile 100.6 to the mouth of Johnson River at mile 101.6, has been classified by the State of Tennessee for the following uses:

- Domestic water supply
- Industrial water supply
- Fish and aquatic life
- Recreation
- Irrigation
- Livestock watering and wildlife
- Navigation

APPENDIX D

APPLICABLE WATER QUALITY STANDARDS

Surface Water

Surface water is as follows: water classified from the mouth to the mouth of the river for:

- Fish and aquatic life

Subsurface Water

Subsurface water is classified from the mouth to the mouth of the river for:

- Domestic water supply
- Fish and aquatic life
- Irrigation
- Livestock watering and wildlife

APPLICABLE WATER QUALITY STANDARDS

Nickajack and Chickamauga Lakes (Tennessee River)

The portion of the study area, included in the reach of the river between the mouth of Chattanooga Creek at Tennessee River Mile 460.6 to the mouth of Hiwassee River at mile 499.4, has been classified by the state of Tennessee for the following uses:

- Domestic raw water supply
- Industrial water supply
- Fish and aquatic life
- Recreation
- Irrigation
- Livestock watering and wildlife
- Navigation

Citico Creek

Citico Creek is an intrastate stream classified from the mouth to the origin for:

- Fish and aquatic life.

South Chickamauga Creek

South Chickamauga Creek is classified from the mouth to the Georgia-Tennessee State Line for:

- Industrial water supply
- Fish and aquatic life
- Irrigation
- Livestock watering and wildlife

Friar Branch

Friar Branch is an intrastate stream classified from the mouth to the origin for:

- Fish and aquatic life
- Irrigation
- Livestock watering and wildlife

North Chickamauga Creek

North Chickamauga Creek is an intrastate stream classified from the mouth to the origin for:

- Fish and aquatic life (classified as a trout stream from mile 13.2 to the headwaters)
- Recreation
- Irrigation
- Livestock watering and wildlife

Criteria for the specific classification are contained in Appendix C.

SURVEILLANCE AND ANALYSIS DIVISION ATHENS, GEORGIA
ENVIRONMENTAL PROTECTION AGENCY REGION IV

CHATTANOOGA FIELD STUDY
(UPSTREAM FROM CITY WATER COMPANY INTAKES) JUNE 1972

AGENCY	PRIMARY STATION	SECONDARY	STATION LOCATION	STATE	MINOR BASIN
1113S000					
470000	1		CITICO CK. UNMD.BR.SOU.MR	TENNESSEE	TENN.R. BASIN SPECIAL STUDY
470003	2		CITICO CK.SO.RR.SYS.STORM DRAIN	TENNESSEE	TENN.R. BASIN SPECIAL STUDY
470006	3		CITICO CK.SO.RR.SYS.STORM DRAIN	TENNESSEE	TENN.R. BASIN SPECIAL STUDY
470009	4		TENN.H.CHATTANOOGA CITY AMNICOLA	TENNESSEE	TENN.R. BASIN SPECIAL STUDY
470012	5		TENN.H.SEABOARD ALLIED MILLING	TENNESSEE	TENN.R. BASIN SPECIAL STUDY
470015	6		TENN.H.CENTRAL SOYA DISCHARGE	TENNESSEE	TENN.R. BASIN SPECIAL STUDY
470018	7		TENN.R.CENTRAL SOYA STORM DRAIN	TENNESSEE	TENN.R. BASIN SPECIAL STUDY
470021	8		S.CHICKAMAUNGA ALCO CHEM.CO.POND	TENNESSEE	TENN.R. BASIN SPECIAL STUDY
470024	9		S.CHICKAMAUNGA ALCO CHEM.CO.DISC	TENNESSEE	TENN.R. BASIN SPECIAL STUDY
470027	10		S.CHICKAMAUNGA ALCO CHEM.CO.DISC	TENNESSEE	TENN.R. BASIN SPECIAL STUDY
470030	11		S.CHICKAMAUNGA MUELLER CO DISCH	TENNESSEE	TENN.R. BASIN SPECIAL STUDY
470033	12		S.CHICKAMAUNGA MUELLER CO EFFLUE	TENNESSEE	TENN.R. BASIN SPECIAL STUDY
470036	13		S.CHICKAMAUNGA W.R GRACE CHEM.CO	TENNESSEE	TENN.R. BASIN SPECIAL STUDY
470039	14		S.CHICKAMAUNGA W.R GRACE CHEM.CO	TENNESSEE	TENN.R. BASIN SPECIAL STUDY
470042	15		S.CHICKAMAUNGA CHATT DUMP N.HAWT	TENNESSEE	TENN.R. BASIN SPECIAL STUDY
470045	16		FRIAR R.GAF CORPORATION DISCHARG	TENNESSEE	TENN.R. BASIN SPECIAL STUDY
470048	17		FRIARS CR. UNMD.BR.FARM CHEM	TENNESSEE	TENN.R. BASIN SPECIAL STUDY
470051	18		TENN.R.VOL.AHMY AMMO PLANT	TENNESSEE	TENN.R. BASIN SPECIAL STUDY
470054	19A		TENN.R.E.I.DUPONT DENEMOURS POND	TENNESSEE	TENN.R. BASIN SPECIAL STUDY
470057	20		TENN.R.E.I.DUPONT DENEMOURS PLT.	TENNESSEE	TENN.R. BASIN SPECIAL STUDY
470060	20A		POE R.TENN.FINISHING MILL DISCHA	TENNESSEE	TENN.R. BASIN SPECIAL STUDY
470063	A		POE B.AT HWY BRIDGE	TENNESSEE	TENN.R. BASIN SPECIAL STUDY
470066	C-1		TENN.H. CHATTANOOGA CITY INTAKE	TENNESSEE	TENN.R. BASIN SPECIAL STUDY
470069	C-1A		CITICO CK 100 YDS UP STR.RIVERSID	TENNESSEE	TENN.R. BASIN SPECIAL STUDY
470072	C-2		CITICO CK 100YDS DOWN FM SO.RR.	TENNESSEE	TENN.R. BASIN SPECIAL STUDY
470075	CR-1		CITICO CK 200YDS UP FM TINKER ST	TENNESSEE	TENN.R. BASIN SPECIAL STUDY
470078	CR-2		CITICO CK-UPSTREAM FM RIVERSIDE	TENNESSEE	TENN.R. BASIN SPECIAL STUDY
470081	CR-3		CITICO CK UPSTREAM LATTA ST.CULV	TENNESSEE	TENN.R. BASIN SPECIAL STUDY
470084	F-1		CITICO CK.75YDS UP FM TECH FINIS	TENNESSEE	TENN.R. BASIN SPECIAL STUDY
470090	F-2		FRIAR B. UPSTREAM OF NEW AIRPORT	TENNESSEE	TENN.R. BASIN SPECIAL STUDY
470093	SC-1		FRIAR B. UPSTREAM OF HWY #153 BRI	TENNESSEE	TENN.R. BASIN SPECIAL STUDY
470099	TAN		S.CHICKAMAUNGA UPSTREAM AMNICOLA	TENNESSEE	TENN.R. BASIN SPECIAL STUDY
470102			TANNERY B.UPSTREAM FM SO RR YARD	TENNESSEE	TENN.R. BASIN SPECIAL STUDY

SURVEILLANCE AND ANALYSIS DIVISION ATHENS, GEORGIA
ENVIRONMENTAL PROTECTION AGENCY REGION IV

CHATTANOOGA FIELD STUDY
(UPSTREAM FROM CITY WATER COMPANY INTAKES) JUNE 1972

DESCRIPTION

PARAMETER

00008	NUMBER USED IN SAMPLE ACCOUNTING PROCEDURE
00010	TEMPERATURE, WATER (DEGREES CENTIGRADE)
00058	FLOW RATE (GALLONS PER MINUTE)
00310	BIOCHEMICAL OXYGEN DEMAND (MG/L; 5 DAY - 20DEG C)
00400	PH (STANDARD UNITS)
00403	PH (STANDARD UNITS) LAB
00500	RESIDUE, TOTAL (MG/L)
00515	RESIDUE, TOTAL FILTHABLE (DRIED AT 105C) MG/L
00530	RESIDUE, TOTAL NONFILTHABLE (MG/L)
00550	OIL-GREASE, TOTAL (MG/L)
00610	NITROGEN, AMMONIA, TOTAL (MG/L AS N)
00625	NITROGEN, KJELDAHL, TOTAL, (MG/L AS N)
00630	NITRITE PLUS NITRATE, TOTAL I DET. (MG/L AS N)
00665	PHOSPHORUS, TOTAL, WET METHOD (MG/L AS P)
00680	CARBON, TOTAL ORGANIC (MG/L AS C)
01034	CHROMIUM, TOTAL (UG/L AS CR)
01042	COPPER, TOTAL (UG/L AS CU)
01045	IRON, TOTAL (UG/L AS FE)
01051	LEAD, TOTAL (UG/L AS PB)
01055	MANGANESE, TOTAL (UG/L AS MN)
01092	ZINC, TOTAL (UG/L AS ZN)
31505	COLIFORM, TOT, MPN, CONFIRMED TEST, 35C (TUBE 31506)
31615	FECAL COLIFORM, MPN, EC MED, 44.5C (TUBE 31614)
32730	PHENOLS (UG/L)
38260	METHYLENE BLUE ACTIVE SUBST. (DETERGENTS, ETC.)
00059	FLOW RATE, INSTANTANEOUS (GALLONS PER MINUTE)
00410	ALKALINITY, TOTAL (MG/L AS CaCO3)
00435	ACIDITY, TOTAL (MG/L AS CaCO3)
01002	ARSENIC, TOTAL (UG/L AS AS)
01105	ALUMINUM, TOTAL (UG/L AS AL)
01102	TIN, TOTAL (UG/L AS SN)
00300	OXYGEN, DISSOLVED (MG/L)

SURVEILLANCE AND ANALYSIS DIVISION ATHENS, GEORGIA
ENVIRONMENTAL PROTECTION AGENCY REGION IV

CHATTANOOGA FIELD STUDY
(UPSTREAM FROM CITY WATER COMPANY INTAKES) JUNE 1972

STATION	DATE	TIME	DATE	TIME	DEPTH	00008 LAB IDENT. NUMBER	00010 WATER TEMP CENT	00058 FLOW RATE GPH	00310 ROD 5 DAY MG/L	00400 PH SU	00403 LAB PH SU	00500 RESIDUE TOTAL MG/L	00515 RESIDUE DISS-105 C MG/L
1	720620	1145				7349	24.0			7.4	7.2	306	286
1	720619	1000(C)	720620	1145		7350							
1	720621	1120				7398	27.0			5.4	7.0	427	412
1	720620	1145(C)	720621	1120		7397		476.00	28.0		6.9	673	650
1	720621	1120(C)	720622	1120		7415		276.00	40.0				
1	720622	1122				7416	27.0			6.4			
1	720623	1145				7454	28.0			5.2	7.2	695	691
1	720622	1120(C)	720623	1145		7453		276.00	24.0				
1	720624	1130				7493	27.0			6.6	6.7	502	459
1	720623	1145(C)	720624	1130		7499		276.00	120.0				
1	720624	1145				7511							
2	720620	1215				7352	21.0			7.3	7.6	478	342
2	720621	1140				7399	22.0		10.0	6.8	8.0	556	551
2	720622	1050				7417	21.0		6.0	7.9	7.6	446	440
2	720623	1055				7455	20.5		38.0	6.6	7.4	644	624
2	720624	1050				7507			72.0		7.4	765	659
3	720620	1415				7335					8.0		
3	720621	1240				7400	21.0		4.0	6.8	8.2	787	777
3	720622	1040				7418	20.0		20.0K	7.8	7.4	820	803
3	720623	1120				7456	18.0		26.0K	6.2	7.5	811	804
3	720624	1105				7506	20.0		20.0K	7.8	7.1	780	777
4	720620	1415				7355	25.0						
4	720621	1200				7401	28.0		60.0	5.8	7.1	1449	1409
4	720622	1345				7431	27.0		20.0	6.3	7.3	1340	1322
4	720623	1325				7473	24.0		40.0	7.0	7.4	1313	1307
4	720624	1150				7494	25.0		110.0	6.2	6.9	1368	1363
										4.6	6.7	1400	1391

SURVEILLANCE AND ANALYSIS DIVISION ATHENS, GEORGIA
ENVIRONMENTAL PROTECTION AGENCY REGION IV

CHATTANOOGA FIELD STUDY
(UPSTREAM FROM CITY WATER COMPANY INTAKES) JUNE 1972

STATION	DATE	TIME	DATE	TIME	DEPTH	00008 LAB IDENT. NUMBER	00010 WATER TEMP CENT	00058 FLOW RATE GPM	00310 BOD 5 DAY MG/L	00400 PH SU	00403 LAB PH SU	00500 RESIDUE TOTAL MG/L	00515 RESIDUE DISS-105 C MG/L
5	720620	1330				7348	22.0			6.0	7.1	359	267
5	720621	1345				7402	31.0		1000.0	4.8	5.5	713	477
5	720622	1410				7432	28.0		1300.0	4.6	4.6	538	420
5	720623	1345				7474	29.0		900.0	5.0	4.6	1348	1280
5	720624	1220				7495	19.0		3500.0	6.2	4.5	2289	869
6	720620	1300				7337	21.0	78.20		6.4	6.8	535	429
6	720619	1100 (C)	720620	1300		7345	22.0	66.70	6.6	6.6	7.6	2671	2597
6	720621	1420				7404	21.0	45.40	10.0	6.9	7.0	2845	2792
6	720620	1300 (C)	720621	1420		7434	29.0	53.60	3.0	6.6	6.7	9147	9129
6	720622	1440				7433	27.5	48.60	3.3	5.6	6.4	2558	2520
6	720621	1420 (C)	720622	1440		7475							
6	720623	1420				7477							
6	720622	1440 (C)	720623	1420		7496							
6	720624	1255				7498							
6	720623	1420 (C)	720624	1255									
7	720620	1245				7344	24.0			6.8	7.7	2778	2704
7	720620	1300				7346	30.5		110.0	8.6	9.2	1472	1409
7	720621	1410				7405	30.0		94.0	8.1	8.3	1310	1278
7	720622	1440				7435	32.0		180.0	6.8	6.5	1209	1119
7	720623	1415				7476			60.0		5.7	1137	1112
7	720624	1250				7497							
8	720620	1100				7363	20.0			9.9	9.8	18900	18180
8	720621	1035				7382	22.0		280.0	8.8	9.7	17750	17500
8	720622	1008				7420	22.0		1600.0K	10.2	9.6	17660	17480
8	720623	1025				7457	20.0		900.0K	9.1	9.7	17560	17370
8	720624	1005				7505	19.0			7.2	9.9	17620	17230

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ENVIRONMENTAL PROTECTION AGENCY REGION IV

CHATTANOOGA FIELD STUDY (UPSTREAM FROM CITY WATER COMPANY INTAKES) JUNE 1972														
STATION	DATE	TIME	DATE	TIME	DEPTH	LAB IDENT. NUMBER	00010	00058	00310	00400	00403	00500	00515	Fluoride mg/l
							WATER TEMP CENT	FLOW RATE GPM	BOD 5 DAY MG/L	PH SU	LAB PH SU	RESIDUE TOTAL MG/L	RESIDUE DISS-105 C MG/L	
9	720620	1115				7361	25.0			8.2				
9	720621	1040				7363	34.0			8.6				
9	720622	1015				7421	32.0			8.3				
9	720623	1035				7458	23.0			7.8				
9	720624	1010				7504	20.0			9.8				
9A	720624	1020				7508								
10	720620	1015				7359	21.0			8.3	7.6	178	137	
10	720619	1300(C)	720620	1015		7358				6.5	8.2	199	107	
10	720621	1000				7385	21.0		5.0	7.3	7.5	206	156	
10	720620	1000(C)	720621	1000		7384		39.00		5.9	6.9	194	102	
10	720622	0925				7423	21.0		7.5	7.6	6.5	223	129	
10	720621	0925(C)	720622	0925		7422		35.00						
10	720623	1000				7460	20.0		12.0					
10	720622	0925(C)	720623	1000		7459		39.00	18.0					
10	720624	0925				7503	27.0							
10	720623	1000(C)	720624	0925		7502		35.00						
11	720620	1030				7357	21.0			7.2	7.0	226	182	
11	720621	1020				7386	25.0		32.0	6.2	7.2	217	179	
11	720622	1000				7424	24.0		74.0	6.8	7.0	235	203	
11	720623	1015				7461	22.0		20.0	6.2	6.3	205	175	
11	720624	0940				7501	20.5		6.0	7.0	6.1	227	220	
12	720619	0700(C)	720620	0900		7364		219.00			11.8	9102	9096	11.4
12	720621	0845				7388	21.5			9.6				
12	720620	0845(C)	720621	0845		7387		219.00			12.3	6201	6180	6.1
12	720622	0830				7426	16.0			11.2				
12	720621	0845(C)	720622	0830		7425		161.00			11.6	4184	4168	5.3
12	720623	0830				7463	14.0			11.8				
12	720622	0830(C)	720623	0830		7462		113.00			11.4			6.0

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CHATTANOOGA FIELD STUDY
(UPSTREAM FROM CITY WATER COMPANY INTAKES) JUNE 1972

STATION	DATE	TIME	DATE	TIME	DEPTH	LAB IDENT. NUMBER	00010 WATER TEMP CENT	00058 FLOW RATE GPM	00310 HOD 5 DAY MG/L	00400 PH SU	00403 LAB PH SU	00500 RESIDUE TOTAL MG/L	00515 RESIDUE DISS-105 C MG/L	Fluoride mg/l
13	720620	0925				7343	21.0			6.2	5.9			5.9
13	720621	0930				7389	21.0			2.0K	4.0			8.3
13	720622	0850				7427	17.0			3.5	3.6			13.0
13	720623	0905				7465	16.0			2.6	3.4			9.6
14	720620	0830				7366	21.0			7.7	7.4	2633	2581	
14	720621	0810				7390	21.0		110.0	5.9	8.1	3641	3558	
14	720622	0810				7419	21.0		80.0	8.1	7.7	3762	3741	
14	720623	0935				7466	21.5		10.0	6.6	7.4	4110	4092	
14	720624	0900				7500	22.0		40.0	6.4	7.5	4671	4633	
15	720619	1100(C)	720620	1435		7373		290.00						
15	720620	1435(C)	720621	1315		7406		330.00	18.0		7.6	2619	2585	
15	720621	1315(C)	720622	1000		7428		280.00	34.0		8.3	3829	3818	
15	720622	0950(C)	720623	0840		7445		280.00	14.0		7.8	3619	3590	
15	720623	0840(C)	720624	0830		7485		200.00	40.0		8.0	4330	4271	
16	720620	0830				7326	20.0							
16	720619	1145(C)	720620	0830		7325		785.00			7.8	361	302	
16	720621	0815				7377	22.0							
16	720620	0830(C)	720621	0815		7376		1722.00	13.0		7.4	718	478	
16	720621	0815(C)	720622	0820		7408		660.00	3.0		8.4	533	521	
16	720623	0950				7443								
16	720622	0815(C)	720623	0950		7444		740.00	10.0K		7.8	485	461	
17	720620	0930				7328	24.0							
17	720619	1250(C)	720620	0930		7327	24.0							
17	720621	0905				7375					7.6	146	70	
17	720620	0930(C)	720621	0905		7374		25600.00	11.0		8.4	607	519	
17	720621	0905(C)	720622	0900		7409		16800.00	5.0		8.3	458	448	
17	720623	0900				7442								
17	720622	0900(C)	720623	0900		7441	28.0	16400.00	5.0		6.7	490	478	

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CHATTANOOGA FIELD STUDY (UPSTREAM FROM CITY WATER COMPANY INTAKES) JUNE 1972													
STATION	DATE	TIME	DATE	TIME	DEPTH	LAB IDENT. NUMBER	00010 WATER TEMP CENT	00058 FLOW RATE GPM	00310 BOD 5 DAY MG/L	00400 PH SU	00403 LAB PH SU	00500 RESIDUE TOTAL MG/L	00515 RESIDUE DISS-105 C MG/L
18	720620	1230				7333	27.0	10400.00			7.7	102	166
18	720619	1530 (C)	720620	1230		7331							
18	720621	1220				7392							
18	720620	1250 (C)	720621	1220		7391		12200.00	14.0		7.3	126	119
18	720621	1220 (C)	720622	1530		7437		6960.00	18.0		6.6	149	132
18	720622	1550				7436	30.0						
18	720623	1430				7470	33.5						
18	720623	0830 (C)	720623	1430		7469		2610.00	28.0K		7.1	222	205
18A	720620	1325				7367	23.0				7.4	119	107
18A	720621	1050				7394	23.0						
18A	720620	1250 (C)	720621	1050		7393			10.0K		7.4	101	86
18A	720622	1500				7438	24.0						
18A	720621	1050 (C)	720622	1500		7439			20.0K		7.5	107	90
18A	720623	1330				7471							
18A	720622	1500 (C)	720623	1330		7472	23.0		28.0K		7.1	158	150
20	720620	1115 (C)	720620	1540		7372					5.6	975	955
20	720621	1100 (C)	720621	1615		7407			595.0		6.5	1653	1625
20	720622	1100 (C)	720622	1600		7440			840.0		4.5	1636	1595
20	720623	0850 (C)	720623	1545		7478	34.0		340.0		6.0	1144	1042
20	720624	0900				7481	20.0		14.0		9.1	9823	9813
20A	720623	0915				7452	16.0		68.0		7.0	447	430
20A	720624	0920				7482	16.0		84.0		7.3	412	407
A	720620	1230				7330							
A	720621	1330				7396							
A	720620	1300 (C)	720621	1330		7395			0.9		8.0		
A	720622	1400				7430							
A	720621	1330 (C)	720622	1400		7429			0.6		7.4		
A	720622	1330 (C)	720623	1330		7467			0.4		7.1		
A	720623	1335				7468							
A	720624	1245				7509							
A	720623	1330 (C)	720624	1245		7510			5.6		6.7		

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CHATTANOOGA FIELD STUDY (UPSTREAM FROM CITY WATER COMPANY INTAKES) JUNE 1972													
STATION	DATE	TIME	DATE	TIME	DEPTH	00008 LAB IDENT. NUMBER	00010 WATER TEMP CENT	00058 FLOW RATE GPM	00310 BOD 5 DAY MG/L	00400 PH SU	00403 LAB PH SU	00500 RESIDUE TOTAL MG/L	00515 RESIDUE DISS-105 C MG/L
C-1	720620	1440				7368	21.0				7.0	215	138
C-1	720621	1015				7378			7.0		6.6	257	221
C-1	720622	1030				7410	21.5		31.0		7.4	433	415
C-1	720623	1015				7446	21.0		5.6		7.0	601	550
C-1A	720623	1000				7447	20.5		1.6		6.8	357	348
C-1A	720624	1050				7490	25.0		38.0L		6.9	518	513
C-2	720620	1415				7369	21.0				7.0	865	705
C-2	720621	1040				7381			3.5		6.7	355	327
C-2	720622	1045				7411	20.0		3.2		7.6	334	329
C-2	720623	0900				7448	21.0		3.1		6.9	314	304
C-2	720624	1030				7491	22.0		2.0		6.9	282	279
CR-1	720623	1715				7479			4.6		7.4	415	241
CR-2	720624	1100				7486	19.0		1.3		7.5	235	214
CR-3	720624	1115				7487			2.2		7.4	240	223
F-1	720620	1520				7370	20.0				7.1	346	72
F-1	720621	0945				7379			9.0		6.8	521	490
F-1	720622	1000				7412	18.0		3.4		7.9	717	697
F-1	720623	0815				7449	16.0		5.2		7.3	581	568
F-1	720624	0915				7483	17.0		7.3		7.5	713	709

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CHATTAHOOGA FIELD STUDY
(UPSTREAM FROM CITY WATER COMPANY INTAKES) JUNE 1972

STATION	DATE	TIME	DATE	TIME	DEPTH	LAB IDENT. NUMBER	00010 WATER TEMP CENT	00058 FLOW RATE GPM	00310 BOD 5 DAY MG/L	00400 PH SU	00403 LAB PH SU	00500 RESIDUE TOTAL MG/L	00515 RESIDUE DISS-105 C MG/L
F-2	720620	1510				7371	20.0				7.1	301	99
F-2	720621	0915				7380			5.4		6.8	292	260
F-2	720622	0945				7413	19.5		3.7		7.9	475	454
F-2	720623	0845				7450	16.0		4.8		7.3	436	326
F-2	720624	0945				7484	17.0		4.2		7.6	399	388
SC-1	720622	1115											
SC-1	720623	1100				7451	20.5		1.0		7.1	207	165
SC-1	720624	1115				7489	22.0		0.6		7.5	130	123
TAN	720623	1815				7480			4.5		7.2	180	154
TAN	720624	1140				7488			9.0		7.5	338	323
STATION	DATE	TIME	DATE	TIME	DEPTH	00530 RESIDUE TOT NFLT MG/L	00550 OIL GRSE TOTAL MG/L	00610 NH3-N TOTAL MG/L	00625 TOT KJEL N MG/L	00630 NO2&NO3 N-TOTAL MG/L	00665 PHOS-T P-WET MG/L	00680 T ORG C MG/L	01034 CHROMIUM CR, TOT UG/L
I	720620	1145					150.0						
I	720619	1000	(C)	720620	1145	20		0.11	0.570	0.220	0.180	36.0	50K
I	720621	1120				15	5.0K						
I	720620	1145	(C)	720621	1120	23		0.13		0.150	0.160	30.0	60
I	720621	1120	(C)	720622	1120		5.0	0.09	0.570	0.190	1.620	44.0	50K
I	720623	1145				4		0.09	0.700	0.160	1.000	42.0	50K
I	720622	1120	(C)	720623	1145	43	17.0	0.20	9.200	0.320	0.290	120.0	90
I	720623	1145	(C)	720624	1130								

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CHATTANOOGA FIELD STUDY
(UPSTREAM FROM CITY WATER COMPANY INTAKES) JUNE 1972

STATION	DATE	TIME	DATE	TIME	DEPTH	00530 RESIDUE TOT NFLT	00550 OIL GKSE TOTAL	00610 NH3-N TOTAL	00625 TOT KJEL N	00630 NO2&NO3 N-TOTAL	00665 PHOS-T P-WET	00680 T ORG C C	01034 CHROMIUM CR.TOT
						MG/L	MG/L	MG/L	MG/L	MG/L	MG/L	MG/L	UG/L
2	720620	1215				136	16.0	2.70	3.300	6.400	3.700	26.0	50
2	720621	1140				5	26.0	2.20	6.160	9.200	0.470	20.0	50K
2	720622	1050				6	49.0	4.10	6.100	6.000	2.220	17.0	50K
2	720623	1055				20	360.0	8.40	8.900	1.320	6.700	38.0	50K
2	720624	1050				106	97.0	23.00	23.000	0.020	22.800	61.0	50K
3	720620	1415					16.0	1.44	2.630	12.400	0.730	19.0	50K
3	720621	1240				10		1.44	2.420	19.800	0.690	18.0	50K
3	720622	1040				17	32.0	1.04	2.270	18.000	0.610	16.0	50K
3	720623	1120				7	27.0	0.50	1.800	17.800	0.530	15.0	50K
3	720624	1105				3	12.0	0.34	1.350	16.300	0.480	14.0	50K
4	720620	1415				40		14.90	17.000	0.500	1.310	87.0	50K
4	720621	1200				18		19.00	19.000	0.010K	1.740	93.0	50K
4	720622	1345				6		12.00	36.000	0.010K	1.590	80.0	50K
4	720623	1325				5		16.00	20.000	0.010K	1.350	75.0	50K
4	720624	1150				9		18.80	19.000	0.010	1.220	76.0	50K
5	720620	1330				92						85.0	50K
5	720621	1345				236						560.0	50K
5	720622	1410				118						680.0	50K
5	720623	1345				68						770.0	50K
5	720624	1220				1420						1750.0	50K
6	720614	1100(C)	720620	1300		106		8.20	21.000	6.500	7.600	160.0	50K
6	720621	1420					5.0K						
6	720620	1300(C)	720621	1420		74		7.40	8.400	0.280	81.000	47.0	90
6	720622	1440					5.0K						
6	720621	1420(C)	720622	1440		53		7.00	8.600	0.450	86.000	47.0	110
6	720623	1420					5.0K						
6	720622	1440(C)	720623	1420		18		6.00	11.000	0.700	84.000	48.0	80
6	720623	1420(C)	720624	1255		38		1.48	7.600	1.690	79.000	51.0	

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CHATTANOOGA FIELD STUDY
(UPSTREAM FROM CITY WATER COMPANY INTAKES) JUNE 1972

STATION	DATE	TIME	DATE	TIME	DEPTH	00530 RESIDUE TOT NFLY MG/L	00550 OIL GRSE TOTAL MG/L	00610 NH3-N TOTAL MG/L	00625 TOT KJEL N MG/L	00630 NO2&NO3 N-TOTAL MG/L	00665 PHOS-T P-WET MG/L	00680 T ORG C C MG/L	01034 CHROMIUM CR.TOT UG/L
7	720620	1245				74		7.20	9.600	0.160	78.000	50.0	
7	720620	1300				63	5.0	0.94	2.600	1.400	13.500	37.0	
7	720621	1410				32	15.0	0.48	2.140	0.840	17.400	37.0	
7	720622	1440				90	71.0	6.40	13.000	0.740	19.600	80.0	
7	720623	1415				25	5.0	0.16	1.120	0.720	18.800	24.0	110
7	720624	1250											
8	720620	1100				720			9.520	0.620	0.940	540.0	50K
8	720621	1035				248			8.200	0.640	0.900	525.0	50K
8	720622	1008				184		0.16	8.200	0.600	0.930	540.0	50K
8	720623	1025				192			9.000	0.530	0.820	480.0	50K
8	720624	1005				388		0.16	11.000	0.600	0.770	550.0	50K
9	720620	1115											
9	720621	1040											
9	720622	1015											
9	720623	1035											
9	720624	1010											
9A	720624	1020										200.0	50K
10	720620	1015											
10	720619	1300(C)	720620	1015		41	5.0K					19.0	50K
10	720621	1000											
10	720620	1000(C)	720621	1000		92	5.0K					24.0	50K
10	720622	0925											
10	720621	0925(C)	720622	0925		50	5.0K					23.0	50K
10	720623	1000											
10	720622	0925(C)	720623	1000		92	5.0					26.0	50K
10	720623	1000(C)	720624	0925		94	5.0K					29.0	50K

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CHATTANOOGA FIELD STUDY
(UPSTREAM FROM CITY WATER COMPANY INTAKES) JUNE 1972

STATION	DATE	TIME	DATE	TIME	DEPTH	00530 RESIDUE TOT NFLT	00550 OIL GKSE TOTAL	00610 NH3-N TOTAL	00625 TOT KJEL N	00630 NO2&NO3 N-TOTAL	00665 PHOS-T P-WET	00680 F URG C C	01034 CHROMIUM CR-TOT
						MG/L	MG/L	MG/L	MG/L	MG/L	MG/L	MG/L	UG/L
11	720620	1030				44		1.92	5.840	0.090	1.500	23.0	50K
11	720621	1020				38		3.36	15.000	0.600	1.810	27.0	50K
11	720622	1000				32		2.70	21.000	0.400	2.460	33.0	50K
11	720623	1015				30		2.64	20.000	0.530	2.500	32.0	50K
11	720624	0940				7		1.16	5.300	0.560	0.820	19.0	50K
12	720619	0700(C)	720620	0900		6		0.01K	0.520	0.380	204.000	260.0	50K
12	720620	0845(C)	720621	0845		21		1.62	1.930	0.630	86.000	23.0	50K
12	720621	0845(C)	720622	0830		16		3.40	5.360	0.600	53.500	5.0	50K
12	720622	0830(C)	720623	0830				1.46	1.400	0.570	68.000	5.0	50K
13	720620	0925						1.60	2.220	0.460	2.460	17.0	50K
13	720621	0930						10.00	10.000	0.070	0.100	8.0	50K
13	720622	0850						6.10	6.140	0.010	0.120	8.0	50K
13	720623	0905						3.60	4.160	0.050	0.150	4.0	50K
14	720620	0830				52		114.00	157.000	35.500	0.530	180.0	90
14	720621	0810				43		200.00	285.000	2.960	0.930	280.0	130
14	720622	0810				21		345.00	345.000	0.180	0.980	375.0	130
14	720623	0935				18		385.00	385.000	0.300	1.000	410.0	200
14	720624	0900				38	20.0	355.00	355.000	20.400	0.860	335.0	170
15	720619	1100(C)	720620	1435		34		121.00	121.000	0.750	0.610	52.0	50K
15	720620	1435(C)	720621	1315		11		103.00	102.000	0.800	0.660	54.0	50K
15	720621	1315(C)	720622	1000		29		99.00	105.000	0.600	0.670	58.0	50K
15	720622	0950(C)	720623	0840		59		102.00	107.000	0.530	0.840	58.0	50K
15	720623	0840(C)	720624	0830		35		96.00	96.000	0.500	0.720	41.0	50K

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CHATTANOOGA FIELD STUDY
(UPSTREAM FROM CITY WATER COMPANY INTAKES) JUNE 1972

STATION	DATE	TIME	DATE	TIME	DEPTH	00530 RESIDUE TOT NFLT	00550 OIL GRSE TOTAL	00610 NH3-N TOTAL	00625 TOT KJEL N	00630 NO2&NO3 N-TOTAL	00665 PHOS-T P-WET	00680 T ORG C C	01034 CHROMIUM CR.TOT
						MG/L	MG/L	MG/L	MG/L	MG/L	MG/L	MG/L	UG/L
16	720619	1145(C)	720620	0830		59		36.00	71.000	42.800	1.160	8.0	180
16	720620	0830(C)	720621	0815		240		78.00	112.000	109.000	0.690	10.0	230
16	720621	0815(C)	720622	0820		12		84.00	100.000	142.000	0.840	8.0	50K
16	720622	0815(C)	720623	0950		24		48.00	50.000	38.500	0.690	6.0	50K
17	720619	1250(C)	720620	0930		76		0.48	1.250	9.900	0.540	7.0	50K
17	720620	0930(C)	720621	0905		48		0.92	1.600	8.500	0.270	7.0	50K
17	720621	0905(C)	720622	0900		10		0.39	1.100	6.950	0.270	6.0	50K
17	720622	0900(C)	720623	0900		12		0.40	1.200	6.200	0.230	6.0	50K
18	720620	1230				16	5.0K		0.550	0.560	0.160	5.0	50K
18	720619	1530(C)	720620	1230			8.0						
18	720621	1220				7		1.90	2.050	0.520	0.140	6.0	50K
18	720620	1250(C)	720621	1220		17		0.21	1.200	0.640	0.400	10.0	70
18	720621	1220(C)	720622	1530			5.0K						
18	720622	1550					5.0K						
18	720623	1430				17		0.90	1.400	0.570	0.430	11.0	100
18	720623	0830(C)	720623	1430									
18A	720620	1325				12	5.0K	0.02	0.190	0.310	0.030	3.0	50K
18A	720621	1050				15	5.0K	0.15	0.250	0.300	0.030	2.0	50K
18A	720620	1250(C)	720621	1050			5.0K						
18A	720622	1500				17	5.0K	0.04	0.100	0.370	0.020	2.0	50K
18A	720621	1050(C)	720622	1500			5.0K						
18A	720623	1330				8	5.0K	0.07	0.250	0.340	0.020	2.0	50K
18A	720622	1500(C)	720623	1330									

SURVEILLANCE AND ANALYSIS DIVISION ATHENS, GEORGIA
ENVIRONMENTAL PROTECTION AGENCY REGION IV

CHATTANOOGA FIELD STUDY
(UPSTREAM FROM CITY WATER COMPANY INTAKES) JUNE 1972

STATION	DATE	TIME	DATE	TIME	DEPTH	00530 RESIDUE TOT NFLT	00550 OIL GHSE TOTAL	00610 NH3-N TOTAL	00625 TOT KJEL N	00630 NO2&NO3 N-TOTAL	00665 PHOS-T P-WET	00680 T ORG C C	01034 CHROMIUM CR-TOT
						MG/L	MG/L	MG/L	MG/L	MG/L	MG/L	MG/L	UG/L
20	720620	1115(C)	720620	1540		20	34.0	0.80	3.810	0.290	1.280	250.0	50K
20	720621	1100(C)	720621	1615		28	45.0	10.60	13.000	1.140	0.810	63.0	50K
20	720622	1100(C)	720622	1600		41	41.0	26.20	27.000	1.170	2.120	680.0	50K
20	720623	0850(C)	720623	1545		102	180.0	40.00	48.000	14.800	1.960	280.0	50K
20	720624	0900				10	5.0K	0.52	1.000	1.240	0.360	8.0	50K
20A	720623	0415				17		1.54	4.600	0.020	1.710	71.0	50K
20A	720624	0920				5		4.56	5.680	0.040	1.710	66.0	50K
A	720620	1230											
A	720621	1330											
A	720620	1300(C)	720621	1330				0.28	0.250	0.440	0.130	3.0	50K
A	720622	1400											
A	720621	1330(C)	720622	1400				0.07	0.210	0.380	0.070	5.0	50K
A	720622	1330(C)	720623	1330								3.0	50K
A	720623	1335											
A	720624	1245											
A	720623	1330(C)	720624	1245				0.26	0.440	0.400	0.060	4.0	50K
C-1	720620	1440				77		0.80	0.770	0.640	0.460	13.0	
C-1	720621	1015				36		0.40	0.850	1.560	0.390	10.0	
C-1	720622	1030				18	89.0	2.68	3.050	1.900	0.810	29.0	
C-1	720623	1015				51	19.0	1.16	1.950	1.300	0.500	14.0	50K
C-1A	720623	1000				9	5.0K	0.49	1.000	1.380	0.710	8.0	50K
C-1A	720624	1050				5	29.0	0.50	9.500	0.540	0.340	84.0	50K

SURVEILLANCE AND ANALYSIS DIVISION ATHENS, GEORGIA
ENVIRONMENTAL PROTECTION AGENCY REGION IV

CHATTANOOGA FIELD STUDY
(UPSTREAM FROM CITY WATER COMPANY INTAKES) JUNE 1972

STATION	DATE	TIME	DATE	TIME	DEPTH	00530 RESIDUE TOT MFL	00550 OIL GRSE TOTAL	00610 NH3-N TOTAL	00625 TOT KJEL N	00630 NO2&NO3 N-TOTAL	00665 PHOS-Y P-DET	00680 T ORG C C	01034 CHROMIUM CM.TOT
						MG/L	MG/L	MG/L	MG/L	MG/L	MG/L	MG/L	UG/L
C-2	720620	1415				160		0.20	1.320	1.980	0.730	34.0	
C-2	720621	1040				28		0.69	0.950	3.100	0.420	10.0	
C-2	720622	1045				5	5.0K	0.43	0.900	2.400	0.330	9.0	
C-2	720623	0900				10	5.0K	0.68	1.200	1.580	0.540	7.0	50K
C-2	720624	1030				3	5.0K	0.34	0.680	1.380	0.340		50K
CW-1	720623	1715				174	5.0K	0.28	0.930	1.600	3.900	9.0	350
CR-2	720624	1100				21	5.0K	0.13	0.650	1.700	6.100	7.0	130
CW-3	720624	1115				17		0.33	0.710	1.790	6.550	7.0	50K
F-1	720620	1520				274		1.40	1.760	1.530	0.350	10.0	
F-1	720621	0945				31		4.20	16.000	14.200	0.220	8.0	
F-1	720622	1000				20	5.0K	20.20	26.000	27.200	0.260	6.0	
F-1	720623	0815				13		17.60	18.000	23.700	0.250	3.0	50K
F-1	720624	0915				4		11.10	13.000	16.400	0.240	4.0	50K
F-2	720620	1510				202		1.14	1.500	1.440	0.320	10.0	
F-2	720621	0915				32		11.00	12.000	12.400	0.180	6.0	
F-2	720622	0945				21		18.70	22.000	30.000	0.230	4.0	
F-2	720623	0845				10		15.00	15.000	21.600	0.240	2.0	50K
F-2	720624	0945				11		8.40	9.600	20.500	0.200	1.0	50K
SC-1	720623	1100				42		0.41	0.900	1.130	0.250	7.0	50K
SC-1	720624	1115				7		0.24	0.450	1.000	0.190	5.0	50K

SURVEILLANCE AND ANALYSIS DIVISION ATHENS, GEORGIA
ENVIRONMENTAL PROTECTION AGENCY REGION IV

CHATTANOOGA FIELD STUDY
(UPSTREAM FROM CITY WATER COMPANY INTAKES) JUNE 1972

STATION	DATE	TIME	DATE	TIME	DEPTH	00530 RESIDUE TOT NFLI MG/L	00550 OIL GWSE TOTAL MG/L	00610 NH3-N TOTAL MG/L	00625 TOT KJEL N MG/L	00630 NO2&NO3 N-TOTAL MG/L	00665 PHOS-T P-WET MG/L	00680 T ORG C C MG/L	01034 CHROMIUM CP.TOT UG/L
TAN	720623	1415				26	5.0K	0.07	0.260	0.250	0.110	4.0	50K
TAN	720624	1140				15	5.0K	0.09	0.830	0.600	0.030	9.0	50K
STATION	DATE	TIME	DATE	TIME	DEPTH	01042 COPPER CU.TOT UG/L	01045 IRON TOTAL UG/L	01051 LEAD PB.TOT UG/L	01055 MANGNESE MN UG/L	01092 ZINC ZN.TOT UG/L	31505 TOT COLI MPN CONF /100ML	31615 FEC COLI MPNECHED /100ML	32730 PHENOLS UG/L
1	720620	1145					1375	100K	260	65	20K	20K	40
1	720619	1000 (C)	720620	1145		50K							
1	720621	1120					1625	100K	360	75	20K	20K	19
1	720620	1145 (C)	720621	1120		50K	2200	100K	520	85			
1	720621	1120 (C)	720622	1120									
1	720622	1122											
1	720623	1145					1075	100K	420	35	20K	20K	17
1	720622	1120 (C)	720623	1145		50K							
1	720624	1130											
1	720623	1145 (C)	720624	1130		50K	875	100K	255	100	20K	20K	23
1	720624	1145											
2	720620	1215				110	4000	140	290	360	1600000	220000	129
2	720621	1140				50K	2250	100K	230	100	490000	49000	16
2	720622	1050				50K	575	100K	245	80	700000	49000	5K
2	720623	1055				70	3400	100K	750	330	9200000	310000	15
2	720624	1050				50K	1050	100K	450	65	24000000L	490000	16
3	720620	1415				50K	1175	100K	115	70			47
3	720621	1240				50K	350	100K	135	140	130000	79000	12
3	720622	1040				50K	400	100K	230	140	17000	4000	5K
3	720623	1120				50K	550	100K	355	185	14000	4000	
3	720624	1105				50	725	100K	475	100			

SURVEILLANCE AND ANALYSIS DIVISION ATHENS, GEORGIA
ENVIRONMENTAL PROTECTION AGENCY REGION IV

CHATTANOOGA FIELD STUDY
(UPSTREAM FROM CITY WATER COMPANY INTAKES) JUNE 1972

STATION	DATE	TIME	DATE	TIME	DEPTH	01042 COPPER CU, TOT	01045 IRON TOTAL	01051 LEAD PB, TOT	01055 MANGNESE MN	01092 ZINC ZN, TOT	31505 TOT COLI MPN CONF	31615 FEC COLI MPNECMED	32730 PHENOLS
						UG/L	UG/L	UG/L	UG/L	UG/L	/100ML	/100ML	UG/L
4	720620	1415				50K	6250	125	23000				
4	720621	1200				50K	3250	100K	6000		490000	490000	
4	720622	1345				50K	2500	100K	6200		1100000	130000	
4	720623	1325				50K	1950	100K	6500		460000	49000	
4	720624	1150				50K	2250	100K	6800		170000	5000	154
5	720620	1330				50	2000	100K	127	150	2400000L	2400000L	
5	720621	1345				50	7000	100K	310	175	70000	33000	
5	720622	1410				50K	14750	100K	440	220	11000	2000K	
5	720623	1345				93	16500	100K	695	150	33000	23000	
5	720624	1220				50K	26250	100K	1400	315	790000	790000	
6	720620	1300											
6	720619	1100(C)	720620	1300		50K	3750	110	215	260	2400000L	2400000L	
6	720621	1420											
6	720620	1300(C)	720621	1420		50K	1400	100K	40	160	2200000	23000	
6	720622	1440											
6	720621	1420(C)	720622	1440		50K	1325	100K	95	230	1300000	22000	5
6	720623	1420											
6	720624	1255				50K	800	100K	100	185	1700000	79000	9
6	720623	1420(C)	720624	1255							9200000	1400000	5
7	720620	1245											
7	720620	1300											
7	720621	1410											13
7	720622	1440											
7	720623	1415				50K	1075	100K	90	205	1600000	70000	
7	720624	1250									1700000	220000	
											1300000	240000	
											13000000	700000	
											490000	70000	

SURVEILLANCE AND ANALYSIS DIVISION ATHENS, GEORGIA
ENVIRONMENTAL PROTECTION AGENCY REGION IV

CHATTANOOGA FIELD STUDY
(UPSTREAM FROM CITY WATER COMPANY INTAKES) JUNE 1972

STATION	DATE	TIME	DATE	TIME	DEPTH	01042	01045	01051	01055	01092	31505	31615	32730
						COPPER CU, TOT	IRON TOTAL	LEAD PB, TOT	MANGNESE MN	ZINC ZN, TOT	TOT COLI MPN CONF	FEC COLI MPNECMED	PHENOLS UG/L
8	720620	1100				50K	325	100K	100	69000			
8	720621	1035				50K	450	100K	112	69000			
8	720622	1008				50K	450	100K	115	70000			
8	720623	1025				50K	450	110	100	69000			
8	720624	1005				50K	450	140	105	71500			
9	720620	1115				50K	725	100K	17	415			
9	720621	1040				50K	150	100K	10K	65			
9	720622	1015				50K	225	100K	10K	584			
9	720623	1035				50K	75	100K	10K	40			
9	720624	1010				50K	75	100K	10K	865			
9A	720624	1020				50K	475	100K	80	12500			
10	720620	1015											43
10	720619	1300(C)	720620	1015		50K	2000	100K	90	135			
10	720621	1000				50K	4750	100K	125	210			69
10	720620	1000(C)	720621	1000									
10	720622	0925				50K	4200	100K	160	140			509
10	720621	0925(C)	720622	0925									
10	720623	1000				50K	4250	100K	165	100			3520
10	720622	0925(C)	720623	1000									
10	720624	0925				50K	3750	100K	140	90			7960
10	720623	1000(C)	720624	0925									
11	720620	1030				50	2200	100K	40	140			
11	720621	1020				75	1300	100K	20	100			
11	720622	1000				60	1625	100K	30	90			
11	720623	1015				50	650	100K	10	65			
11	720624	0940				80	900	100K	10K	175			

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CHATTANOOGA FIELD STUDY
(UPSTREAM FROM CITY WATER COMPANY INTAKES) JUNE 1972

STATION	DATE	TIME	DATE	TIME	DEPTH	01042 COPPER CU, TOT UG/L	01045 IRON TOTAL UG/L	01051 LEAD PB, TOT UG/L	01055 MANGNESE MN UG/L	01092 ZINC ZN, TOT UG/L	31505 TOT COLI MPN CONF /100ML	31615 FEC COLI MPNECHED /100ML	32730 PHENOLS UG/L
12	720619	0700	(C) 720620	0900		50K	150	100K	10	25			
12	720620	0845	(C) 720621	0845		50K	775	100K	20	20			
12	720621	0845	(C) 720622	0830		50K	225	100K	10	25			
12	720622	0830	(C) 720623	0830		50K	125	100K	10	10K			
13	720620	0925				50K	37750	100K	19000	190			
13	720621	0930				50K	43750	100K	42000	535			
13	720622	0850				50K	49500	100K	42000	30			
13	720623	0905				50K	37750	125	39000	215			
14	720620	0830				55	10500	100K	955	250	240000	17000	
14	720621	0810				65	15250	140	710	360	170000	4600	
14	720622	0810				57	14750	100K	795	395	79000	1400	
14	720623	0935				50	15250	190	800	395	43000	200	
14	720624	0900				57	4500	205	815	415	2200	200K	17
15	720619	1100	(C) 720620	1435		50K	300	100K	20	130			
15	720620	1435	(C) 720621	1315		50K	325	100K	35	130			
15	720621	1315	(C) 720622	1000		50K	350	100K	40	150			
15	720622	0950	(C) 720623	0840		50K	325	125	40	125			
15	720623	0840	(C) 720624	0830		50K	275	100	30	125			
16	720620	0830				50K	2025	100K	80	185	140000	4900	
16	720619	1145	(C) 720620	0830		50K					2000	2000	
16	720621	0815				50K	9500	100K	425	290	20K	20K	
16	720620	0830	(C) 720621	0815		50K	900	100K	145	135	2000K	2000K	
16	720622	0820				50K							
16	720621	0815	(C) 720622	0820		50K							
16	720623	0950				50K							
16	720622	0815	(C) 720623	0950		50K	1250	100K	90	75			

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CHATTANOOGA FIELD STUDY
(UPSTREAM FROM CITY WATER COMPANY INTAKES) JUNE 1972

STATION	DATE	TIME	DATE	TIME	DEPTH	01042 COPPER CU.TOT	01045 IRON TOTAL	01051 LEAD PB.TOT	01055 MANGNESE MN	01092 ZINC ZN.TOT	31505 TOT COLI MPN CONF	31615 FEC COLI MPNECMED	32730 PHENOLS
						UG/L	UG/L	UG/L	UG/L	UG/L	/100ML	/100ML	UG/L
17	720620	0930											
17	720619	1250(C)	720620	0930		50K	3250	100K	195	40	1100	790	
17	720621	0905											
17	720620	0930(C)	720621	0905		50K	4500	100K	245	35	1100	20	
17	720622	0900											
17	720621	0905(C)	720622	0900		50K	975	100K	130	25	20	20K	
17	720623	0900											
17	720622	0900(C)	720623	0900		50K	900	100K	175	20	230	20K	
18	720620	1230											
18	720619	1530(C)	720620	1230		50K	625	100K	60	170	7900	170	17
18	720621	1220											
18	720620	1250(C)	720621	1220		50K	650	100K	100	75	1300	80	36
18	720621	1220(C)	720622	1530			650	100K	105	75			
18	720622	1550											
18	720623	1430											
18	720623	0830(C)	720623	1430		50K	600	100K	85	65	70	20K	5K
18A	720620	1325											
18A	720621	1050				105	625	100K	95	30	1300	20	14
18A	720620	1250(C)	720621	1050		50K	2500	100K	95	465	1300	40	6
18A	720622	1500											
18A	720621	1050(C)	720622	1500		50	1425	100K	95	270	460	20K	5K
18A	720623	1330											
18A	720622	1500(C)	720623	1330		57	700	100K	65	230	220	20	26
20	720620	1115(C)	720620	1540									
20	720621	1100(C)	720621	1615		50K	600	100K	20	210			152
20	720622	1100(C)	720622	1600		50K	975	100K	55	150			487
20	720623	0850(C)	720623	1545		130	450	100K	70	150			2770
20	720624	0900				50K	250	100K	85	150			237
20									30	30			

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CHATTANOOGA FIELD STUDY
(UPSTREAM FROM CITY WATER COMPANY INTAKES) JUNE 1972

STATION	DATE	TIME	DATE	TIME	DEPTH	01042 COPPER CU, TOT	01045 IRON TOTAL	01051 LEAD PB, TOT	01055 MANGNESE MN	01092 ZINC ZN, TOT	31505 TOT COLI MPN CONF	31615 FEC COLI MPN/100ML	32730 PHENOLS UG/L
20A	720623	0915				50K	1625	100K	530	25			
20A	720624	0920				50K	1100	100K	405	15			
A	720620	1230											
A	720621	1330											
A	720620	1300	(C)	720621	1330	85	1600	100K	100	215		4900	8
A	720622	1400										7900	12
A	720621	1330	(C)	720622	1400	95	1900	100K	95	30		1100	5K
A	720622	1330	(C)	720623	1330	90	975	100K	80	15			
A	720623	1335										1400	5K
A	720624	1245										170	5K
A	720623	1330	(C)	720624	1245	105	925	100K	85	20			
C-1	720620	1440											
C-1	720621	1015											
C-1	720622	1030											
C-1	720623	1015				50K	3300	100K	730	970		13000	9
												22000	8
												2000K	
												2000	
C-1A	720623	1000				50K	700	100K	440	365		2000K	5K
C-1A	720624	1050				50K	875	100K	605	30		20K	60
C-2	720620	1415											
C-2	720621	1040										24000	
C-2	720622	1045										11000	7
C-2	720623	0900				50K	1025	100K	365	15		49000	5
C-2	720624	1030				50K	400	100K	405	30		2000K	5K
												2000K	

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ENVIRONMENTAL PROTECTION AGENCY REGION IV

CHATTANOOGA FIELD STUDY (UPSTREAM FROM CITY WATER COMPANY INTAKES) JUNE 1972													
STATION	DATE	TIME	DATE	TIME	DEPTH	01042 COPPER CU, TOT UG/L	01045 IRON TOTAL UG/L	01051 LEAD PB, TOT UG/L	01055 MANGNESE MN UG/L	01092 ZINC ZN, TOT UG/L	31505 TOT COLI MPN CONF /100ML	31615 FEC COLI MPNECHMED /100ML	32730 PHENOLS UG/L
CR-1	720623	1715				50K	7800	100K	615	65	22000	2700	5K
CR-2	720624	1100				50K	1050	100K	315	75	17000	2400	21
CR-3	720624	1115				50K	1250	100K	305	30			
F-1	720622	1000				50K	350	100K	45	10K			5K
F-1	720623	0815				50K	300	100K	70	30			
F-1	720624	0915											
F-2	720622	0945				50K	500	100K	90	10K			5K
F-2	720623	0845				50K	450	100K	100	10K			
F-2	720624	0945											
SC-1	720623	1100				50K	2500	100K	95	45	7000	940	
SC-1	720624	1115				50K	775	100K	50	10K	11000	490	
TAN	720623	1815				50K	525	100K	105	10K	11000	800	5K
TAN	720624	1140				50K	1050	100K	350	10K	13000	3300	5K

STATION	DATE	TIME	DATE	TIME	DEPTH	38260 MBAS	00059 FLOW RATE	00410 T ALK CACO3	00435 T ACIDITY CACO3	01002 ARSENIC AS, TOT	01105 ALUMINUM AL, TOT	01102 TIN SN, TOT	00300 DO
						MG/L	INST-GPM	MG/L	MG/L	UG/L	UG/L	UG/L	MG/L
I	720619	1000(C)	720620	1145		4.10							
I	720620	1145(C)	720621	1120		1.20							
I	720621	1120(C)	720622	1120		1.70							
I	720622	1120(C)	720623	1145		5.40							
I	720623	1145(C)	720624	1130		2.10							

SURVEILLANCE AND ANALYSIS DIVISION ATHENS, GEORGIA
ENVIRONMENTAL PROTECTION AGENCY REGION IV

CHATTANOOGA FIELD STUDY
(UPSTREAM FROM CITY WATER COMPANY INTAKES) JUNE 1972

STATION	DATE	TIME	DATE	TIME	DEPTH	38260 MBAS	00059 FLOW RATE	00410 T ALK CACO3	00435 T ACIDITY CACO3	01002 ARSENIC AS.TOT	01105 ALUMINUM AL.TOT	01102 TIN SN.TOT	00300 DO
						MG/L	INST-GPM	MG/L	MG/L	UG/L	UG/L	UG/L	MG/L
2	720621	1140					90.00						
2	720622	1050					30.00						
2	720623	1055					13.00						
2	720624	1050					7.00						
3	720623	1120					120.00						
3	720624	1105					66.00						
4	720620	1415					263.00	477		51			5K
4	720621	1200					113.00	810		98			5K
4	720622	1345					56.00	850		100			5K
4	720623	1325					39.00	920		140			5K
4	720624	1150					32.00	960		150			5K
5	720621	1345					30.00						
5	720622	1410					5.00						
5	720623	1345					6.00						
5	720624	1220					1.00						
7	720620	1245					368.00						
7	720621	1410					32.00						
7	720622	1440					35.00						
7	720623	1415					47.00						
7	720624	1250					51.00						
8	720620	1100						103					0
8	720621	1035						940					0
8	720622	1008						1000					0
8	720623	1025						8700					0
8	720624	1005						8700					0

SURVEILLANCE AND ANALYSIS DIVISION ATHENS, GEORGIA
ENVIRONMENTAL PROTECTION AGENCY REGION IV

CHATTANOOGA FIELD STUDY
(UPSTREAM FROM CITY WATER COMPANY INTAKES) JUNE 1972

STATION	DATE	TIME	DATE	TIME	DEPTH	MBAS	00059 FLOW RATE	00410 T ALK CACO3	00435 T ACIDITY CACO3	01002 ARSENIC AS-TOT	01105 ALUMINUM AL-TOT	01102 TIN SN-TOT	00300 DO
						MG/L	INST-GPM	MG/L	MG/L	UG/L	UG/L	UG/L	MG/L
9	720620	1115				38260							
9	720621	1040					144.00						
9	720622	1015					129.00						
9	720623	1035					113.00						
9	720624	1010					87.00						
							100.00						
11	720620	1030					28.00						
11	720621	1020					47.00						
11	720622	1000					55.00						
11	720623	1015					55.00						
11	720624	0940					47.00						
12	720619	0700 (C)	720620	0900				4100	0				
12	720620	0845 (C)	720621	0845				2020	0				
12	720621	0845 (C)	720622	0830				1580	0				
12	720622	0830 (C)	720623	0830				1900	0				
13	720620	0925					65.00						
13	720621	0930					15.00						
13	720622	0850					8.00						
13	720623	0905					7.00						
14	720620	0830					27.00	1150	129				5K
14	720621	0810					18.00	2240	0				5K
14	720622	0810					13.00	5100	380				5K
14	720623	0935					12.00	2600	480				5K
14	720624	0900					10.00	2700	390				5K

SURVEILLANCE AND ANALYSIS DIVISION ATHENS, GEORGIA
ENVIRONMENTAL PROTECTION AGENCY REGION IV

CHATTANOOGA FIELD STUDY
(UPSTREAM FROM CITY WATER COMPANY INTAKES) JUNE 1972

STATION	DATE	TIME	DATE	TIME	DEPTH	MBAS	00059 FLOW RATE INST-GPM	00410 T ALK CACO3 MG/L	00435 T ACIDITY CACO3 MG/L	01002 ARSENIC AS-TOT UG/L	01105 ALUMINUM AL-TOT UG/L	01102 TIN SM-TOT UG/L	00300 DO MG/L
15	720619	1100(C)	720620	1435				210	24		1000		
15	720620	1435(C)	720621	1315				200	0				
15	720621	1315(C)	720622	1000				260	20				
15	720622	0950(C)	720623	0840				280	12				
15	720623	0840(C)	720624	0430				280	20				
16	720619	1145(C)	720620	0630				83	10	15			
16	720620	0830(C)	720621	0815						8			
16	720621	0815(C)	720622	0820						8			
16	720622	0815(C)	720623	0950									
17	720619	1250(C)	720620	0930				21	5	5K			
17	720620	0930(C)	720621	0905				28	0	5K			
17	720621	0905(C)	720622	0900				30	0	5K			
17	720622	0900(C)	720623	0900				22	4	5K			
20	720620	1115(C)	720620	1540				66	41			450K	
20	720621	1100(C)	720621	1615				162	48			450K	
20	720622	1100(C)	720622	1600				0	430			450K	
20	720623	0850(C)	720623	1545				140	160			450K	
20	720624	0900						140	0			450K	
20A	720623	0915						120	12				0
20A	720624	0920						120	12				0
A	720620	1300(C)	720621	1330									
A	720621	1330(C)	720622	1400		0.10K							
A	720622	1330(C)	720623	1330		0.10K							
A	720623	1330(C)	720624	1245		0.10K							

SURVEILLANCE AND ANALYSIS DIVISION ATHENS, GEORGIA
ENVIRONMENTAL PROTECTION AGENCY REGION IV

CHATTANOOGA FIELD STUDY
(UPSTREAM FROM CITY WATER COMPANY INTAKES) JUNE 1972

STATION	DATE	TIME	DATE	TIME	DEPTH	38260 MBAS	00059 FLOW RATE	00410 T ALK CACO3	00435 T ACIDITY CACO3	01002 ARSENIC AS.TOT	01105 ALUMINUM AL.TOT	01102 TIN SN.TOT	00300 DO
						MG/L	INST-GPH	MG/L	MG/L	UG/L	UG/L	UG/L	MG/L
C-1	720620	1440											5.5
C-1	720621	1015											2.2
C-1	720622	1030											2.3
C-1	720623	1015											2.3
C-1A	720623	1000											2.3
C-1A	720624	1050											4.1
C-2	720620	1415											5.7
C-2	720621	1040											3.8
C-2	720622	1045											2.1
C-2	720623	0900											1.5
C-2	720624	1030											1.1
CR-1	720623	1715											
CR-2	720624	1100											
F-1	720620	1520											6.8
F-1	720621	0945											6.0
F-1	720622	1000											6.6
F-1	720623	0815											6.7
F-2	720620	1510											6.9
F-2	720621	0915											6.5
F-2	720622	0945											7.4
F-2	720623	0845											7.7

UPSTREAM FROM CITY WATER COMPANY INTAKES) JUNE 1972

1000K

APPENDIX F ORGANIC COMPOUNDS IDENTIFIED

Run Number	Sample Name	Peak Number	Retention Time (min)	Mass Spectrum	Identification
101	Sample 101	1	1.23	...	...
102	Sample 102	2	2.45	...	...
103	Sample 103	3	3.67	...	...
104	Sample 104	4	4.89	...	...
105	Sample 105	5	6.11	...	...
106	Sample 106	6	7.33	...	...
107	Sample 107	7	8.55	...	...
108	Sample 108	8	9.77	...	...
109	Sample 109	9	10.99	...	...
110	Sample 110	10	12.21	...	...
111	Sample 111	11	13.43	...	...
112	Sample 112	12	14.65	...	...
113	Sample 113	13	15.87	...	...
114	Sample 114	14	17.09	...	...
115	Sample 115	15	18.31	...	...
116	Sample 116	16	19.53	...	...
117	Sample 117	17	20.75	...	...
118	Sample 118	18	21.97	...	...
119	Sample 119	19	23.19	...	...
120	Sample 120	20	24.41	...	...

ANALYST: J. L. ...
DATE: 10/10/1991
INSTRUMENT: ...

CHEMICAL SERVICES BRANCH
SAD, EPA, REGION IV
ATHENS, GEORGIA 30601

ORGANIC COMPOUNDS IDENTIFIED

PROJECT	Chattanooga Survey	SAMPLING DATE	June, 1972				
SAD number	Industry or Source	Organic Compound	Conc. Found mg/L	Chemical Formula	Chemical Class	Water Solubility	Stability
7512	Amnicola City Dump -4	fenchone	0.042		ketone	insoluble	
7512	Amnicola City Dump -4	camphor	0.031		ketone	slightly soluble	
7512	Amnicola City Dump -4	alpha terpineol	0.023		alcohol	slightly soluble	
7512	Amnicola City Dump -4	D-fenchyl alcohol	<0.01		alcohol	insoluble	
7512	Amnicola City Dump -4	cymene	<0.01		terpene	insoluble	
7512	Amnicola City Dump -4	There are five unknown compounds in the same concentration range. alcohols.			They appear to be primarily		
7513	Alco Chemical Co -8	N,N-diethylformamide	est. at <1.0		amide	miscible	
7513	Alco Chemical Co -8	dibutylamine	est. at <1.0		amine	insoluble	
7513	Alco Chemical Co -8	normal butylisothiocyanate	0.5		iso- thiocyanate	insoluble	
7513	Alco Chemical Co -8	triethyl urea	6.4		urea	soluble	

ORGANIC COMPOUNDS IDENTIFIED AND ENVIRONMENTAL
EFFECTS OF EACH

SAD Number	Organic Compound	Conc. Found mg/L	Toxicity Data mg/kg of Body Weight	Fish Toxicity mg/L	Taste & Odor
7512	fenchone	0.042	unknown	unknown	camphor like odor
7512	camphor	0.031	to rat - intraperitoneal LD 50: 900 mg/kg (1)	unknown	minn. conc. that can be tasted 1.9 mg/l (4)
7512	alpha terpineol	0.023	unknown	unknown	lilac odor
7512	D-fenchyl alcohol	<0.01	unknown	unknown	unknown
7512	cymene	<0.01	For p-cymene, 1h LC ca. 5000 mg/kg rat (1)	unknown	aromatic odor
7512					
7513	N,N,-diethylformamide	<1.0	unknown	unknown	unknown
7513	dibutyl amine	est. <1.0	lethal dose for rats - oral route: 500 mg/kg (1)	critical range for creek chub 20-60 mg/L (3)	amine odor
7513	n-butyliothiocyanate	0.5	unknown	unknown	unknown
7513	triethyl urea	6.4	unknown	unknown	unknown

CHEMICAL SERVICES BRANCH
SAD, EPA, REGION IV
ATHENS, GEORGIA 30601

ORGANIC COMPOUNDS IDENTIFIED

PROJECT	Chattanooga Survey	SAMPLING DATE	June, 1972	Chemical Formula	Chemical Class	Water Solubility	Stability
SAD CASE	Industry or Source	Organic Compound	Conc. Found mg/L	Chemical Formula	Chemical Class	Water Solubility	Stability
7513	Alco Chemical Co -8	ethylisothiocyanate	est. at <1.5	<chem>CCNC=S</chem>	iso- thiocyanate	insoluble	
7513	There are approximately 15-20 other unidentified compounds in the same concentration range. They appear to be other isothiocyanates.						
7514	Alco-Small holding pond	normal - butyl isothiocyanate	0.10	<chem>CCCCNC=S</chem>	iso- thiocyanate	insoluble	
7514	Alco-Small holding pond	benzothiazole	0.16	<chem>c1cc[nH]c2ccccc12</chem>	heterocyclic	slightly soluble	
7514	Alco-Small holding pond	pentachlorophenol	est. at <0.4	<chem>ClC1(Cl)(Cl)C(Cl)(Cl)C1</chem>	phenol	insoluble	
7514	Alco-Small holding pond	There are also 30 - 35 unidentified compounds in the concentration range of 0.01 - 0.5 mg/L. They are primarily isothiocyanates, ureas, amides, phenols, and alcohols.					
7515	Hawthorne Dump	2-phenyl-2-propenol	0.11	<chem>C=C(Cc1ccccc1)O</chem>	alcohol	slightly soluble	
7515	Hawthorne Dump	The remaining organic compounds appear to be components of oil and grease and are in the 0.01 - 0.05 mg/l range.					
7516	CAF	pentachlorophenol	0.05	<chem>ClC1(Cl)(Cl)C(Cl)(Cl)C1</chem>	phenol	insoluble	
7516	CAF	benzothiazole	<0.01	<chem>c1cc[nH]c2ccccc12</chem>	heterocyclic	slightly soluble	

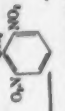
ORGANIC COMPOUNDS IDENTIFIED AND ENVIRONMENTAL
EFFECTS OF EACH

SAD Number	Organic Compound	Conc. Found mg/L	Toxicity Data mg/kg of Body Weight	Fish Toxicity mg/L	Taste & Odor
7513	ethylisothiocyanate	est. at <1.5	unknown	unknown	pungent odor
7514	normal - butyl isothiocyanate	0.10	unknown	unknown	unknown
7514	benzothiazole	0.16	lethal dose for mice by intra- venous inj: 100 mg/kg (1)	unknown	unpleasant odor
7514	pentachlorophenol	est. at <0.4	very toxic, probable lethal dose for humans-50-500 mg/kg(2)	0.2-0.6 mg/L toxic to 19 varieties of fish (4)	unknown
7515	2-phenyl-2 propanol	0.11	unknown	unknown	sweet floral odor
7516	pentachlorophenol	0.05	very toxic - probable lethal dose for humans-50-500 mg/kg(2)	0.2-0.6 mg/L toxic to 19 varieties of fish (4)	unknown
7516	benzothiazole	<0.01	lethal dose for mice by intra- venous inj.: 100mg/kg (1)	unknown	unpleasant odor

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CHEMICAL SERVICES BRANCH
SAD, EPA, REGION IV
ATHENS, GEORGIA 30601

ORGANIC COMPOUNDS IDENTIFIED

PROJECT	Chattanooga Survey	SAMPLING DATE	June, 1972	Organic Compound	Conc. Found mg/L	Chemical Formula	Chemical Class	Water Solubility	Stability
SAD number	Industry or Source								
7516	GAF			Sample very likely contains about 0.01 mg/L of 2-(methylthio) benzothiazole. No standard available for verification.					
7516	GAF			There are 12-16 other organic compounds present in the 0.01-0.05 concentration range. Several appear to be alkyl phenols.					
7517	Volunteer AAP			o-nitrotoluene	0.15		nitrotoluene	0.0652 gm/100 ml	
7517	Volunteer AAP			2,6-dinitrotoluene	0.68		nitrotoluene	unknown	
7517	Volunteer AAP			There are three other isomeric forms of dinitrotoluene present. Concentration range is 0.03 - 0.06 mg/L.					
7517	Volunteer AAP			Sample very likely contains about 0.7 mg/L of trinitrotoluene. No standard available for verification.					
7517	Volunteer AAP			There are 4-6 other organic compounds in a concentration range of 0.01 - 0.03 mg/L. They appear to be acids and phthalates.					
7517	Volunteer AAP			Sample very likely contains about 0.4 mg/L of 4,4'-diamino-dicyclohexyl methane. There is no standard available for verification.					
7518	DuPont			There are no other organic compounds detected at >0.01 mg/L.					
7518	DuPont			No organic compounds detected at >0.01 mg/L.					
7519	DuPont - Influent								

ORGANIC COMPOUNDS IDENTIFIED AND ENVIRONMENTAL EFFECTS OF EACH

[illegible]

ORGANIC COMPOUNDS IDENTIFIED

PROJECT Chattanooga Survey

[illegible]

APPENDIX G

CORRESPONDENCE

CORRESPONDENCE

The following letter was sent to each of the 11st of addressees on June 8, 1972, between the time of the EPA reconnaissance and the beginning of the study. The only variation was that the specific location was spelled out to city officials in lieu of the words "your premises" on the fourth line. All officials notified were extremely courteous and cooperative.

ENVIRONMENTAL PROTECTION AGENCY

189

Region IV
Surveillance and Analysis Division
Athens, Georgia 30601

June 8, 1972

Mr. Chester H. Hill
Hills' Hosiery Mill
Box 68
Daisy, TN 37319

Dear Mr. Hill:

This letter is to notify you of the Environmental Protection Agency's waste source study to be conducted in the Chattanooga area later this month. Mr. Charles Sweatt, Mr. Rodney Davis, I, or possibly another EPA employee will be visiting your premises (in addition to other waste sources in the area) to collect liquid waste discharge samples. The purpose of the survey is to collect information and water quality data which will be used as the basis for: (1) Evaluation of Corps of Engineers Permits as required under the River and Harbor Act of 1899; (2) determination of present water quality conditions in the Tennessee River and its tributaries in the Chattanooga area upstream from the water supply intake; (3) evaluation of individual and collective impacts of wastewater discharges on beneficial uses of the Tennessee River and its tributaries (4) determination of water pollution control needs within the area; and (5) abatement proceedings of necessary or warranted under the River and Harbor Act of 1899, the Water Quality Act of 1965, and/or other applicable local, State and Federal laws.

Your cooperation in the conduct of this study is essential to the success of the Clean Water effort and is therefore earnestly solicited.

Sincerely,

David W. Hill, Ph.D., P.E.
Chief, Industrial and Special Studies

Mr. James H. O'Rourke
Vice President & General Manager
Alco Chemical Corporation
P. O. Box 5141
Chattanooga, TN 37406

Mr. W. B. Davis
Plant Manager
W. R. Grace & Co.
Davison Chemical Division
4000 N. Hawthorne Street
Chattanooga, TN 37406

Mr. J. A. Rust
Chief Engineer
Design and Construction
Southern Railway System
99 Spring Street, S. W.
Atlanta, GA 30303

Mr. Harry L. Stapleton
Director of Sanitation
Seaboard Allied Milling Corp.
1550 West 29th Street
Kansas City, MO 64108

Mr. James Templeton
General Superintendent
Department of Public Works
12th Street and Park Avenue
City Yards Office
Chattanooga, TN 37406

Mr. Leonard Maiorano
Tennessee Finishing & Dyeing Co.
Daisy, TN 37319

Mr. Chester H. Hill
Hills' Hosiery Mill
Box 68
Daisy, TN 37319

Mr. K. C. Gustafson
Environmental Control Coordinator
E. I. DuPont deNemours & Co.
P. O. Box 71
Chattanooga, TN 37401

Mr. William H. Yochum
Plant Manager
Central Soya Company, Inc.
Judd Road
Chattanooga, TN 37406

Mr. Earl E. Bright
Plant Manager
The Mueller Co.
1401 Mueller Avenue
Chattanooga, TN 37406

Mr. R. E. McMahon
Plant Manager
GAF Corporation
Polymer Department
1228 Chestnut Street
P. O. box 6037
Chattanooga, TN 37401

Mr. Edward C. Bingham
Farmers Chemical Association, Inc.
P. O. Box 87
Harrison, TN 37341

Commanding Officer
Volunteer Army Ammunition
Plant
Chattanooga, TN 37401

APPENDIX H

PROJECT PERSONNEL

PROJECT PERSONNEL

Herbert C. Barden - Project Microbiologist
Tom B. Bennett, Jr. - Project Chemist
William Rodney Davis - Industrial Chemist
James R. Green - Data Specialist
David W. Hill - Project Director
Wilburn F. Holsomback - Computer Specialist
Charles H. Hooper - Chemist
Raymond P. Lawless - Chemist
E. William Loy - Organic Chemist
William H. Peltier - Aquatic Biologist
Edward E. Shollenberger - Engineering Technician
Charles A. Sweatt - Project Engineer
M. Ronald Weldon - Aquatic Biologist
Roy A. Wiemert - Draftsman
Raymond T. Wilkerson - Engineering Technician